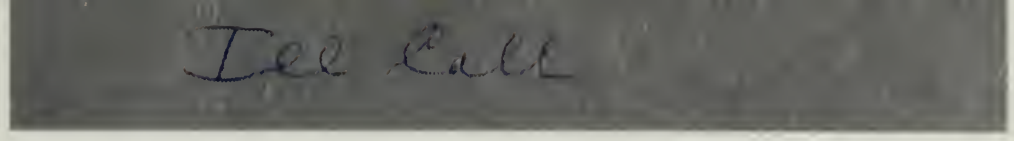

DEPARTMENT OF AGRICULTURAL ECONOMICS
UNIVERSITY OF ILLINOIS
AGRICULTURAL EXPERIMENT STATION

ILLINOIS AGRICULTURAL ECONOMICS

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WITH THIS FIRST ISSUE

the Department of Agricultural Economics begins publication of a new periodical intended to provide timely economic information for leaders in agriculture and agriculturally related industries as well as for our professional colleagues in agricultural economics.

Agricultural economics, as a field of study, is concerned with the business or financial side of farm production, marketing, and processing. It encompasses such subject-matter areas as farm and land management, production economics, marketing, rural sociology, prices and statistics, agricultural finance, public policy, and agricultural law. The articles in *Illinois Agricultural Economics* will be based on research of the Department and will be concerned mainly but not exclusively with Illinois.

Research by members of the Department staff is organized around major problem areas and includes analyses of all types of agricultural business, starting with the farm and extending through the entire structure of marketing to the final consumer. These research efforts directly support our functions of resident teaching and extension education. In addition to the regular research staff, nearly all of whom also teach courses, many graduate students make significant contributions to our research program in the form of theses, which are required for advanced degrees. From time to time the principal results of some of their work will also be published in this periodical. We expect *Illinois Agricultural Economics* to reflect the wide subject-matter areas of the Department and to thereby promote better understanding on the part of its readers of the many facets of the agricultural economy of Illinois.

This issue is being sent to you because we believe you will be interested in this new development. You will also receive the second issue, after which you may indicate your interest in receiving it regularly.

H. G. HALCROW

Head, Department of Agricultural Economics

The Market for Domestic Farm Food Products

T. A. HIERONYMUS

PROBLEMS OF AGRICULTURAL adjustment and agricultural income support are closely related to the size, present and prospective, of the market for farm products. Farmers are businessmen, engaged in producing useful and desired products for sale. The nature of agricultural production and the adjustments that take place in agriculture in the times ahead will be basically established by the structure of the market for the end products of agriculture. Attempts to aid agriculture and agricultural adjustments must be made within the scope of existing markets.

General Considerations

The size of the domestic market for farm food products is affected by several considerations. Each of these plays an important role in determining the amount of agricultural production that is absorbed and the revenue that is gained from its sale.

Population. Population is only one of several factors in the total market size. Frequently one hears statements that indicate that market size is a precise arithmetic function of population — such statements as "The human stomach will hold only so much." True, we require a reasonably constant quantity of food in terms of pounds or calories, but a given quantity of food does not represent a fixed quantity of agriculture.

At least 70 percent of the cropland used to produce food and feed is used to produce feed. This land could, if needed, be shifted back to food crops. For every seven units of nutrients that go into livestock, we get about one back for use as human food. Clearly, a shift from animal products to crop products would enable us to feed several times the current population without any increase in agricultural production. Similarly, a shift from the production of food crops to feed crops with an accompanying increase in the consumption of livestock products would increase the amount of agricultural production used per capita.

Per capita income. As individual family incomes increase, food expenditures also increase. Thus the revenue that is realized from the sale of food is influenced by per capita income. The well-being of agriculture is closely tied to the well-being of consumers.

Taste and preferences. A minimum amount of food is essential to the maintenance of life, health, and vigor. But the consumption of food in the United States — by amount and kind — is far in excess of such a minimal level. The agricultural industry can sell people only what they want to buy. The size of the market is importantly affected by the preferences of people for food over all of the other demands upon their incomes. Agriculture must compete, on a preference basis, with all of the other sellers of consumer goods.

The ability of the marketing system to supply the market. These notions of consumer preference point up the importance of evolving a marketing system that will fully cater to consumer desires.

The U.S. marketing system is highly developed. The system of transportation, processing, preparation, and distribution is tremendously complex. It provides many thousands of kinds of food items in every corner of the country at all times.

There is need, however, to improve the marketing system. There is need to improve the quality and standardization of products, reduce the costs of marketing through increases in efficiency, and continue innovations in processes and products.

The price of the product. If agriculture is to attract consumer expenditures away from other items to food, its products must be priced attractively. In spite of the emphasis that should be placed on quality, we must recognize that we are selling in a very price-conscious market. All products are more or less competitive in the quest for consumer spendable income: apples with oranges, fruit with meat, food with household appliances, clothing with recreation, etc.

Consumer Expenditures

As go the developments in the factors affecting market size so will also go the rate of market expansion during the decade ahead. The behavior of consumers during the postwar period is an important indication of their probable behavior in the future.

Total and adjusted expenditures. Consumer expenditures for food increased rapidly during the post-World War II period (Figure 1 and Table 1). The size of the market increased by more than 50 percent — from $45.8 billion to $69.9 billion. Projection of this increase into the future requires that we be optimistic about the size of the domestic market. The factors that caused the increase during the 1947-1959 period will be likely to prevail in the future, so such projection appears reasonable. Three factors were responsible for the increase: (1) general inflation, (2) increasing population, and (3) increasing real per capita income.

To separate these three influences, the expenditures were first adjusted for the price of food. The adjusted expenditures (total food expenditures divided by index of consumer prices for food) are shown by the dotted line in Figure 1. Thus computed, the increase amounted to $12.4 billion, about one-half of the actual amount.

The total food expenditures were then adjusted for changes in population. The result (shown by the broken line in Figure 1) is an approximation of the real growth in per capita market size during the period. It is based on two assumptions: (1) because food-price increases were part of the general infla-

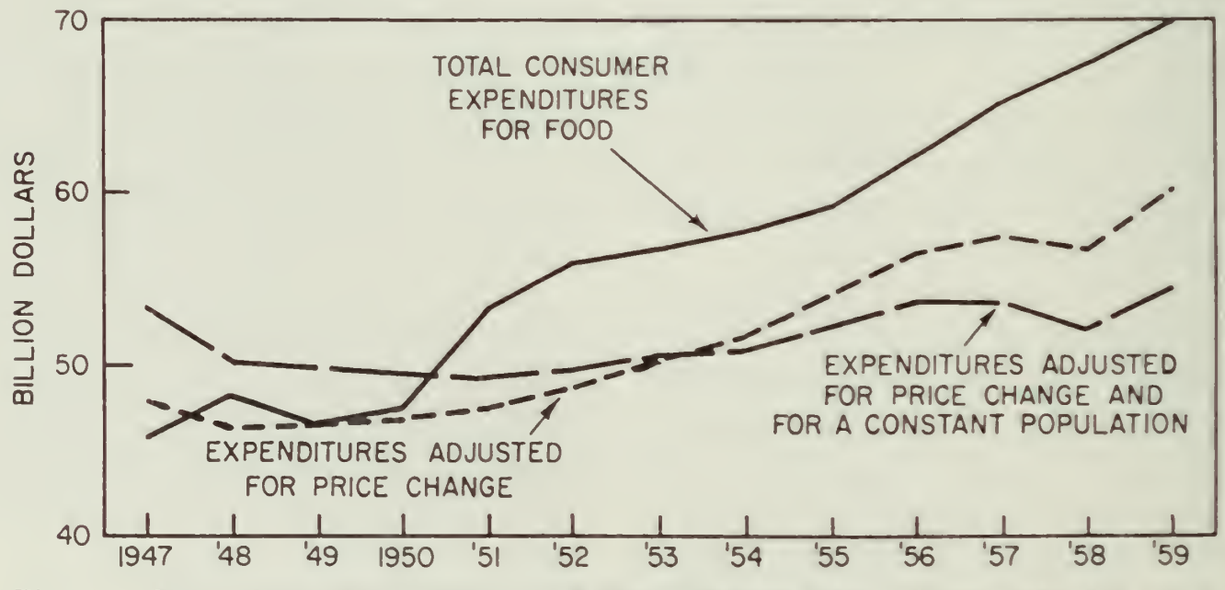


Fig. 1. — Total food expenditures and expenditures after adjustments for price change and for price change and a constant population of 160 million. (Based on USDA data.)

Table 1. — Some Aspects of Consumer Behavior in the Post-World War II Period

Year	Food expenditures	Disposable personal income	Cost of living	Cost of food	Population	Food expenditures adjusted for food prices	DPI adjusted for cost of living
	(billion dollars)		(1947-1949 = 100)		(million)	(billion dollars)	
1947	45.8	170.1	95.5	95.9	144.0	47.8	178.1
1948	48.2	189.3	102.8	104.1	146.8	46.3	184.1
1949	46.4	189.7	101.8	100.0	149.2	46.4	186.3
1950	47.4	207.7	102.8	101.2	151.6	46.8	202.0
1951	53.4	227.5	111.0	112.6	154.2	47.4	205.0
1952	55.8	238.7	113.5	114.6	157.0	48.7	210.3
1953	56.6	252.5	114.4	112.5	159.6	50.3	220.7
1954	57.7	256.9	114.8	111.9	162.4	51.6	225.4
1955	59.2	274.4	114.5	109.7	165.2	54.0	239.7
1956	62.2	290.5	116.2	110.2	168.0	56.4	250.0
1957	65.2	305.1	120.2	113.8	171.1	57.3	253.8
1958	67.4	316.5	123.5	118.8	174.1	56.7	256.3
1959	69.9	336.6	124.2	116.1	177.1	60.2	271.0

Year	Adjusted food expenditures per capita	Adjusted DPI per capita	Percent adjusted values spent for food	Food expenditures adjusted to provide a 1952 dietary level	Food expenditures adjusted for constant population of 160 million
	(dollars)	(dollars)	(percent)	(billion dollars)	
1947	331.94	1,236.81	26.8	46.5	53.1
1948	315.40	1,254.09	25.1	50.2	50.1
1949	310.99	1,248.66	24.9	48.1	49.8
1950	308.71	1,332.45	23.2	48.0	49.4
1951	307.39	1,329.44	23.1	54.3	49.2
1952	310.19	1,339.49	23.2	55.8	49.6
1953	315.16	1,382.83	22.8	55.0	50.4
1954	317.73	1,387.93	22.9	55.1	50.8
1955	326.88	1,450.97	22.5	55.1	52.3
1956	335.71	1,488.10	22.6	56.2	53.7
1957	334.89	1,483.34	22.6	59.2	53.6
1958	325.67	1,472.14	22.1	63.7	52.1
1959	339.92	1,530.21	22.2	63.3	54.4

Source: Marketing and Transportation Situation and AMS data, USDA.

tion of the period, food expenditures necessarily went up at the same rate as food prices; and (2) food expenditures increased in direct proportion to the increase in population.

For the years 1947-1951, there was a decrease in real market size per capita. This decrease was in part the result of adjustment from a wartime expenditures pattern. Because goods and services other than food were scarce during the war, money for food was more than usually available. This readjustment had essentially taken place by 1949 or 1950. Since 1950 there has been a gradual and persistent increase in real per capita expenditures for food.

Income elasticity. Figure 2 shows the relationship between disposable real income per capita and real food expenditures per capita during the decade of the 1950's. Two things are readily apparent: First, both income and food expenditures rose fairly rapidly and, second, the increase in income was greater than the increase in food expenditures.

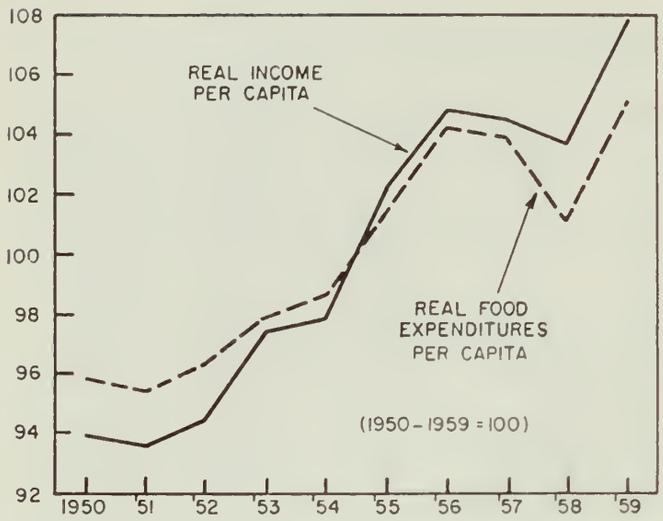


Fig. 2. — Indexes of income and food expenditures. (Based on USDA data.)

Although these data are useful in estimating the income elasticity of the demand for food, they have some limitations. For example, they do not take into account the increase in per capita production of food. Presumably consumers react initially in two ways to a decrease in food prices. One is to continue to eat as they have, but at lesser cost; the other is to improve the quality of the food they buy or to improve the quality of "mix" of the products they buy. The result is probably a short-run price inelasticity of demand. The secondary effects, or long-run price elasticity, are uncertain and much argued. If, however, the price elasticity of demand in the short run is less than one, then the data tend to understate income elasticity of demand.

From 1950 to 1959, real food expenditures increased 10.3 percent per capita, while real income went up 14.8 percent per capita. A crude income elasticity of +0.7 is indicated; that is, food expenditures increased 70 percent as rapidly as consumer incomes.

Expenditures for constant diet. It has not been necessary for consumers to spend such large amounts for food as they have been spending. Figure 3 shows actual consumer food expenditures together with the expenditure that would have been necessary to maintain a diet of constant composition. The figures shown for food expenditures and diets have been equated at 1952 levels. In each year previous to 1952, expenditures were below the levels needed to buy a 1952 diet, and each year since 1952 they have been above.

In 1935-1939 consumers would have had to spend $21.1 billion to obtain a 1952 diet. They actually spent $15.3 billion, or only 72.5 percent as much. In 1959 consumers spent $6.6 billion more than they would have needed had they been content with 1952 dietary levels. It is clear that consumers are willing to

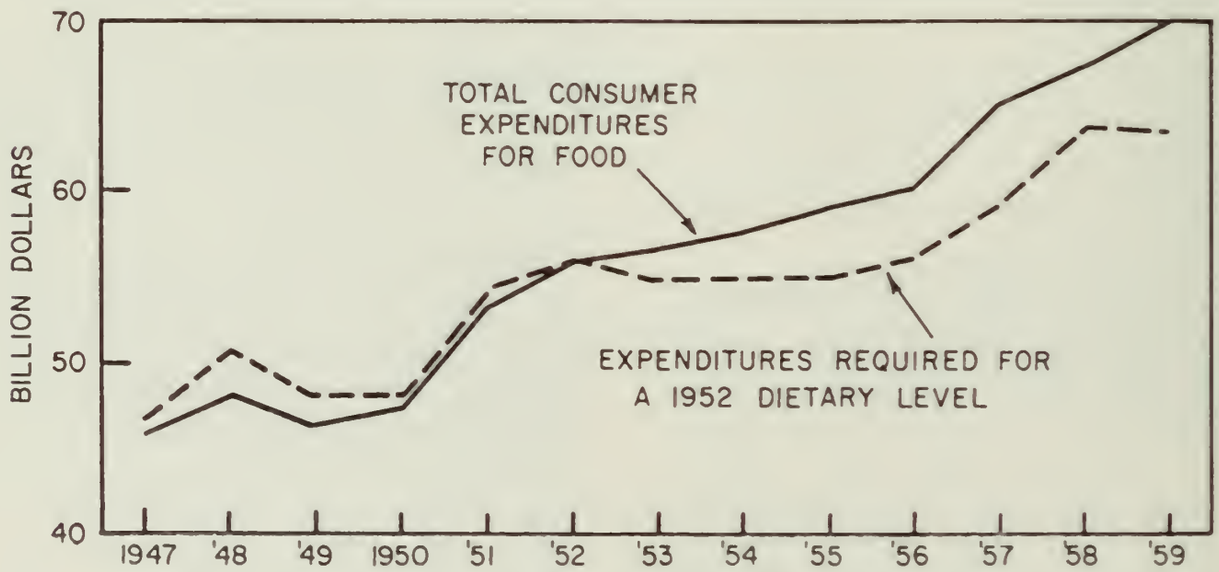


Fig. 3. — How total food expenditures and expenditures necessary to maintain a diet of a constant composition have risen.

spend part of their increased income in improving the quality of the food they buy. In this context, quality improvement refers to preference rather than to nutrition.

Dietary changes. The increased expenditures have been made for preferred foods. What are these preferred foods? The changes in food products that have taken place during the past 15 years would be a subject in itself.

The per capita consumption of fruits and vegetables has been essentially stable. There have been some internal shifts, especially from fresh to frozen fruits and vegetables. Although postwar per capita consumption of fruits and vegetables appears to have stabilized, there has been a very large increase from prewar. Just what this means is not clear. It could mean that we are reaching a saturation point. But in view of the wide differences in consumption by families, this conclusion appears doubtful. A more likely view is that the gains are being consolidated and that a renewed expansion of consumer demand is probable.

Per capita consumption of livestock and livestock products is continuing to expand after a very large increase from prewar levels. Within the livestock products component, the greatest increase is in meat. After a dramatic increase from prewar levels, per capita egg consumption has decreased in each year since 1951. Consumption of dairy products other than butter is expanding slowly. Whether the markets, per capita, for eggs and milk have been saturated or whether other factors are to blame is not known. Markets do become saturated, that is, consumption reaches levels past which no more is wanted or can be used. For example, the per capita consumption of edible fats and oils just cannot be increased at any price. On the other hand, there is reason to suspect that milk is being priced out of markets and that the quality of eggs is so low as to discourage consumption, so there is substantial doubt that these markets are saturated.

It is also clear that there is much room for expansion of per capita meat consumption. New records have been established in recent years, and supplies have been readily taken up. The per capita meat consumption in the United States is well below that of several other countries. If the time ever comes when the meat appetites are satiated in a quantity sense, we can turn to quality improvement. When we consider the willingness with which consumers have increased their expenditures for meat, and at the same time think of the amount of canner cow beef and fat pork that we have been able to sell, it becomes clear that meat consumption can be expanded.

Consumption of bread, potatoes, and hominy grits declined. As the consumption of animal products increases, something must go. It has been the carbohydrate foods.

As consumption shifts from bread and potatoes to meat, the per capita intake of agricultural products is greatly increased. This again illustrates the distillation effect of putting crops through animals and shows the absence of a direct arithmetic relationship between the amounts of agricultural products that can be consumed and the numbers of people available to consume them.

Conclusion. During the decade of the 1950's, real food expenditures per capita increased by more than 1 percent per year. During the same decade, population increased by 17 percent, or about 1.9 percent per year. It thus appears that the increase in size of the domestic market for food was of the general order of 3 percent per year. There is a rapidly expanding market for food. It does

not seem unreasonable to project about this same rate of expansion into the decade of the 1960's.

Marketing Margins

If the market for farm food products was increasing at a rate of 3 percent per year, why has a severe agricultural income problem developed? The answer lies in the relative adjustments of the prices of agricultural commodities and marketing margins to inflation.

The margin structure. One of the things we frequently hear is that increased consumer expenditures for food do not increase the demand for farm products, because these increased consumer expenditures are absorbed by increased marketing costs. Another is that the increased expenditures for food are not really for food at all, but are actually for increased marketing services — for built-in maid service. That increased expenditures for food have been absorbed by increased marketing charges is partly true. That increased expenditures have been for services rather than food is not true.

Marketing charges and farm receipts divide up consumer expenditures. This division is as follows:

1. Consumers spend a given amount of money for a given amount, kind, and quality of food. This amount is independent of the division of expenditures between marketing charges and farm receipts.
2. Marketing charges are based on costs, and so an amount generally approximating the cost of marketing is taken out of consumer expenditures.
3. The balance that is left is paid to farmers for the raw foodstuffs. Farmers are the residual recipients, taking what is left over.

Relative changes. Sometimes it is advantageous to be the residual recipient, and sometimes it is not. Figure 4 shows retail food costs, total marketing bill, and farm value of foods produced from domestic farm products from 1935 through 1959.

For the period 1935-1948, it was advantageous to be the residual claimant. Consumer expenditures for food increased at the full general inflationary rate of the economy during the war and postwar period. Marketing costs are sticky, and so they increased more slowly. Such things as transportation rates, rentals, utilities, and even wage

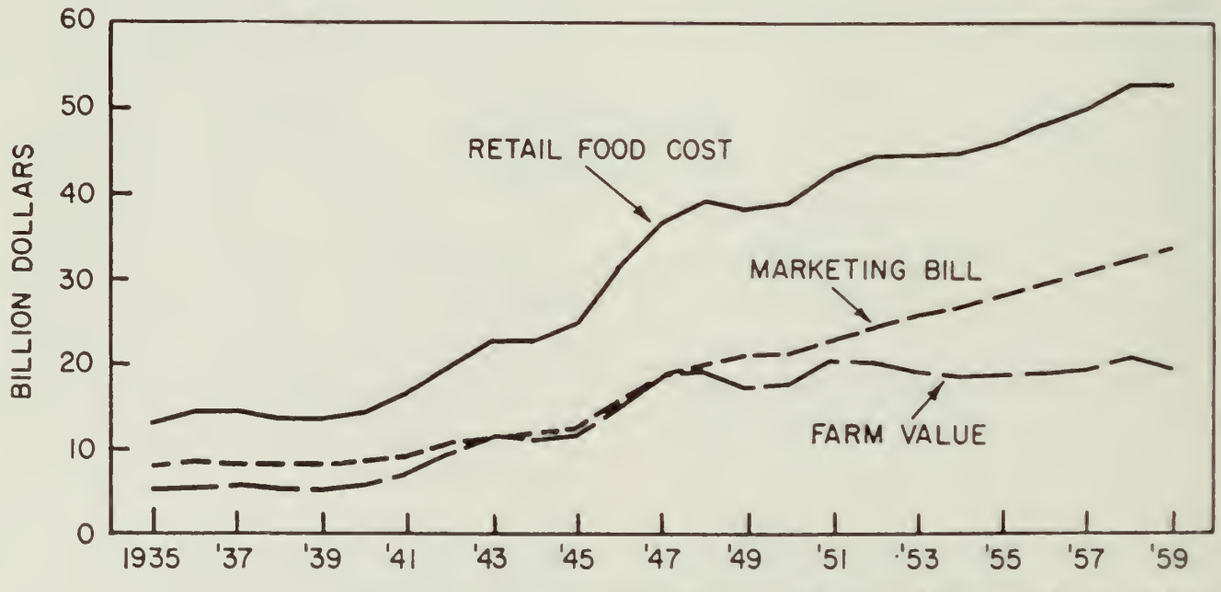


Fig. 4. — Retail cost of domestic food production, marketing bill, and farm value. (Based on USDA data.)

rates usually lag during inflationary periods. Consequently the residual left for farmers increased faster than the general economic expansion and inflation. For example, consumer expenditures increased 191 percent from 1939 to 1948, while marketing charges increased only 141 percent. The resultant increase in farm value was 269 percent. This situation was too good to last. Like the tortoise, marketing charges began to catch up with the hare of inflation. From 1948 to 1959, consumer expenditures went up 36 percent, marketing charges 68 percent, and farm value only 3 percent.

If the rate of increase in marketing charges decreases until it becomes the same as the rate of increase in consumer expenditures, farm value will increase at the same rate as consumer expenditures. Thus the rate of increase in marketing charges is of particular importance at the present time.

Component costs. We can learn something about the various component costs of marketing (hourly labor rates, transportation rates, and other cost rates) and unit marketing charges by looking at Figure 5. The outstanding thing about this picture is that all of the components have increased faster than the unit charges. Had input costs remained constant, unit charges would have decreased. This change must have been the result of increasing efficiency or a change in the amount of marketing service, or both. If there was an increase in marketing service — built-in maid service — it has been more than offset by increased efficiency. There are both increases and decreases in the amount of marketing service. There is more prepreparation and packaging, but these cut down the amount of retailing. They also cut waste and hence increase efficiency.

Either directly or indirectly, labor makes up most of the freight and other marketing costs. Laborers are consumers, and vice versa. It is difficult for me to see how marketing wage scales can continue to gain on other wage scales and how wage rates in general can rise

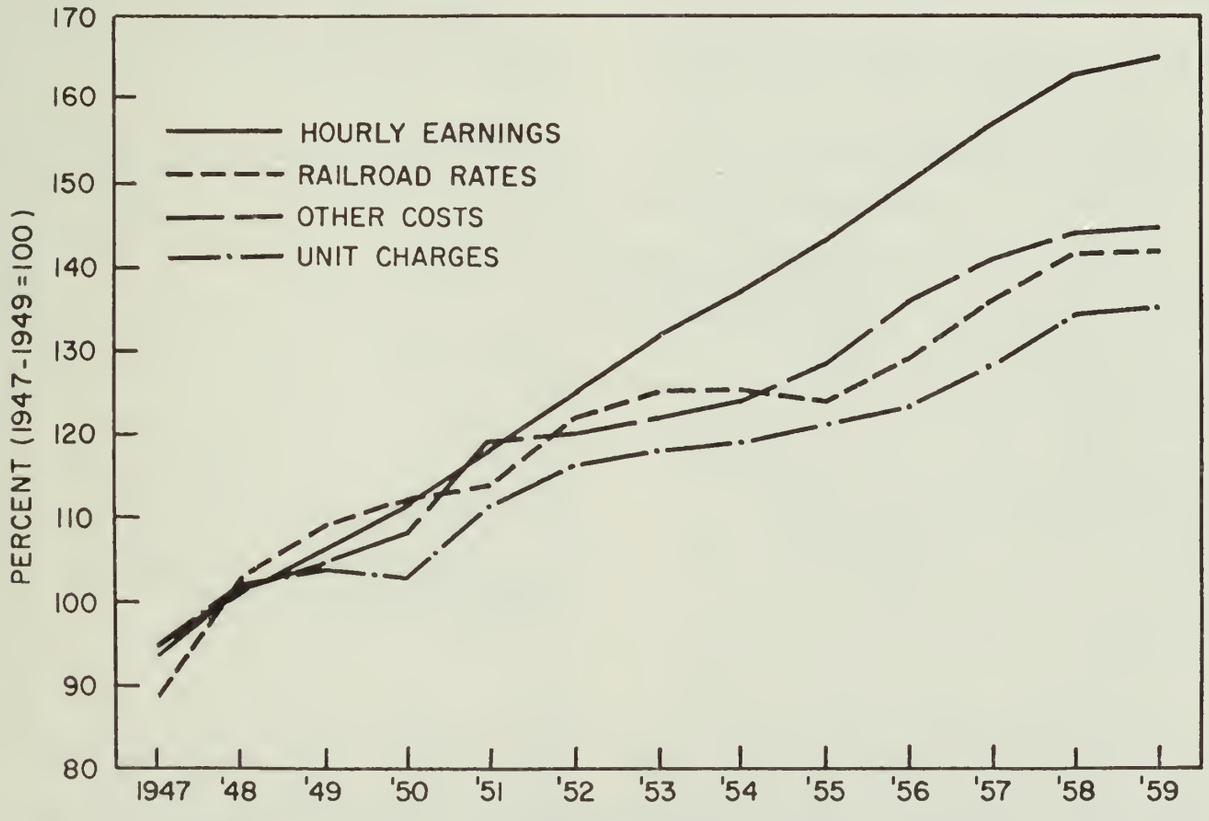


Fig. 5. — Indexes of component marketing costs and unit charges. (Based on USDA data.)

without the increase being translated, at least in part, into consumer expenditures for food. It follows, therefore, that in the future, consumer expenditures and unit marketing charges will increase at more nearly the same proportionate rate, leaving room for increases in farm value more nearly in line with increases in consumer expenditures. Agriculture may have weathered this phase of adjustment.

Effects on farm income. The impact of increased unit marketing charges is illustrated in Table 2 and Figure 6, which show the actual farm value and the farm value that would have existed had unit marketing charges increased at the same rate as consumer expenditures from the 1947-1949 period to 1959. This substantial difference, had it existed, would have been largely translated into net farm income. If net farm income had been $6.3 billion larger than it was in 1959, it is doubtful that we would be hearing so much about the farm income problem in 1960.

By this process a plausible case can be developed to show that the farm income problems of the past decade are due to inflation catching up in the area of marketing charges and to the wage-price inflation rather than to overproduction.

Most importantly, what it means is that in the decade ahead there will be outstandingly better opportunities for increasing farm income than there have been in the decade just ended.

Table 2. — Actual Farm Value of Consumer Expenditures for Domestic Farm Food Products Bought by Civilians, Compared With Farm Value Had the Marketing Bill Increased at the Same Rate as Consumer Expenditures From the 1947-49 Averages

Year	Actual farm value	Computed farm value
	(billion dollars)	
1947	18.7	17.7
1948	19.3	18.9
1949	16.9	18.0
1950	17.6	18.6
1951	20.0	20.8
1952	19.9	21.6
1953	19.0	21.7
1954	18.4	21.9
1955	18.3	22.7
1956	18.7	23.7
1957	19.5	24.7
1958	20.8	25.9
1959	19.8	26.1

Supply Policy

None of this discussion considers the effect of changes in the supply of agri-

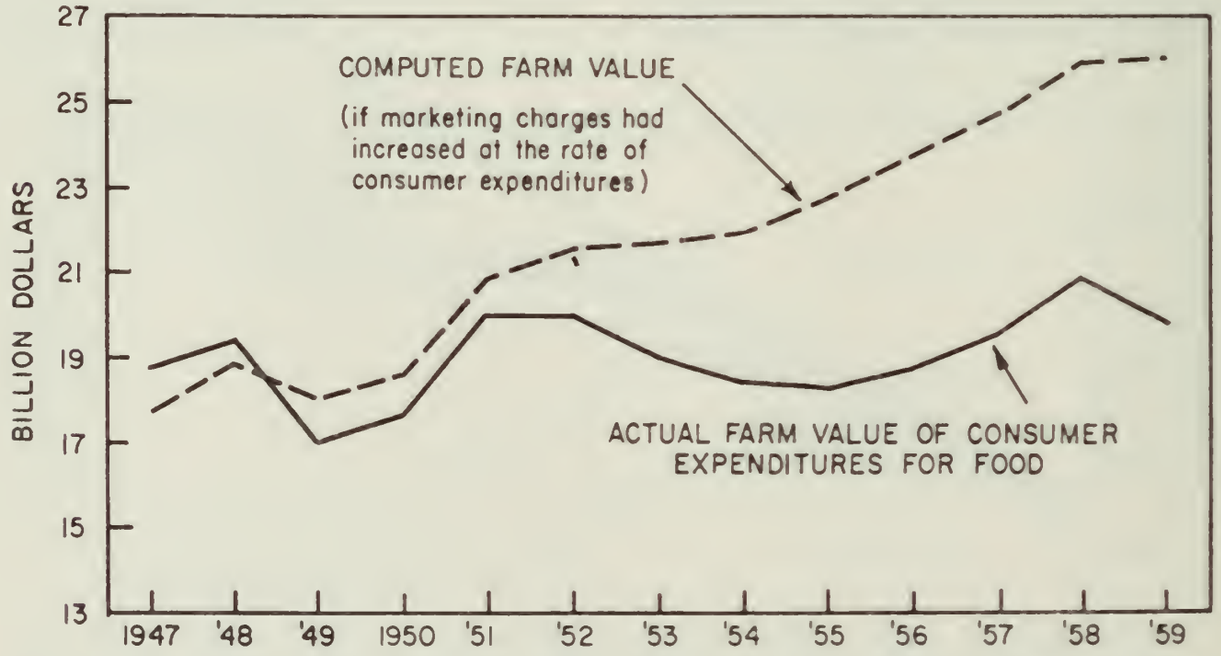


Fig. 6. — Farm value of consumer expenditures for food — actual and computed on basis of smaller increases in marketing charges.

cultural products on agricultural prices and incomes. There are, however, implications for supply policy in market size and growth. A restrictive supply policy would have adverse effects on market growth, hence on the size of the farming industry.

If agriculture raises the prices of its end products in relation to the prices of other consumer items, consumer expenditures will be diverted elsewhere. The result will be a net revenue loss to agriculture. Thus in the long run, a relative increase in price tends to stop the expansion, in a quantity sense, in size of the market for agricultural products, and to stop the expansion of agricultural production. Thus the size of the agricultural plant tends to become fixed. In a situation in which one of the most serious problems is the underemployment of resources, people in particular, restriction of supply further complicates the adjustment problem. Thus one of the key considerations in adjustment is maximization of market size. This cannot be accomplished with a high-price policy.

A restrictive supply policy would retard market development. Market development is built on quality improvement. Quality improves faster when supply is not restricted. Under any supply-control conditions, competition among producers is restricted; and so the likelihood of quality improvement is reduced. Further, under any supply-control conditions, there is a tendency to freeze the relative production of the various agricultural commodities. In so far as the wrong commodities are produced, the market will not expand. If it were possible to effectively restrict supply, and if such restriction succeeded in increasing incomes to satisfactory levels, there would be less incentive to improve quality than there is under the competitive conditions that generally exist.

Some illustrations may be in order: One of the most remarkable examples of growth during the postwar period is the broiler industry. It was built on quality and an advancing technology. I put a simple proposition: The market for chicken meat would be much smaller today had production patterns been frozen at the levels of 20 years ago. The well-exercised, expensive, barnyard chicken of that era would not attract much consumer spending today. The money would be going elsewhere, and not necessarily to other food items.

The soybean industry is another example of remarkable growth in recent times. This product has been continuously priced to move and has found expanded markets at a phenomenal rate. Other fats and oils, those of foreign origin in particular, have been displaced. Livestock feeding efficiency, especially for poultry, has been improved through the use of soybean meal. At one time soybean oil and soybean meal were regarded as inferior products. Their quality has been greatly improved, and they have proved their quality. The simple proposition here is that these vast new outlets for corn-belt agriculture would not have been opened up if effective supply control had been in operation.

The development of market outlets for the large quantities of feed grains that are being produced and that have accumulated rests heavily on the attractiveness of pork to consumers. This is a weak foundation. The quality of pork is low. One of the key agricultural adjustment problems is to improve pork quality. A price of $18 or $20 for hogs does not give much incentive for invention, of which necessity is the mother.

The market effects of supply control must not be overlooked in agricultural policy discussions.

Illinois Tax Trends

N. G. P. KRAUSZ

GOVERNMENT BENEFITS, ONCE they have become established and people have become used to them and depend on them, are quite difficult to remove or cut back. Each new addition to the structure thus tends to become a permanent fixture, and it is not difficult to explain why. The desire to continue a program is very real and personal to those who are receiving its benefits. If their numbers are sufficient, it may be impossible to bring about even minor changes. The desire of economy-minded persons to reduce taxes, however, is not nearly so immediate and pressing. In other words, those who are directly affected by loss of a government program have more at stake and are more likely to voice their protests than are those who merely wish to see a general reduction in taxes.

In addition, the federal government through federal-aid programs, actively encourages states to tax for certain purposes by guaranteeing "free" federal money on a matching basis. Programs for old-age assistance and aid to dependent children are examples of such assistance. Such programs are hard for state legislatures to resist, because some of those federal funds were obtained from taxes collected within the state, and this represents a way for the state to recover some of that money. If the state does not wish to take its share, it is usually allocated to another state that is willing to match dollars.

The trend in state spending has been a steady increase during the postwar period. Although many persons appear to favor government economy, they reverse their position when the projects from which they benefit are endangered. There is no real evidence of any substantial decrease in government spending in the near future. On the contrary, most signs seem to indicate that, if there is to be any change in spending, it will be upward.

Population Changes Causing Greater Revenue Needs

The population of Illinois is increasing at the rate of 1.7 percent per year. More governmental services are demanded, and there is a lag between this demand and treasury receipts from these new citizens. The following figures show how Illinois population has grown and is expected to grow:

Year	Total all ages	Under 18 years	18 to 64 years	65 years and older
		(in thousands)		
1950.....	8,712.....	2,408	5,553	751
Percent of total.....		27.6	63.8	8.6
1955.....	9,301.....	2,907	5,532	862
Percent of total.....		31.2	59.5	9.3
1960.....	10,300.....	3,502	5,789	1,009
Percent of total.....		34.0	56.2	9.8
1965.....	11,200.....	3,897	6,149	1,154
Percent of total.....		34.8	54.9	10.3
1970.....	12,300.....	4,268	6,740	1,292
Percent of total.....		34.7	54.8	10.5

Of importance from a taxpayer's viewpoint is the increasing percentage of school-aged and older persons. Both of these groups require additional state assistance, and this means, of course, additional taxes. The following tabulation shows the steady growth, for example, in the proportion of the Illinois population under 18 years old.

Year	Preschool (under 5)	School age 5 to 17)	Percent of population under 18
	(in thousands)		
1950.....	843	1,564	27.6
1951.....	906	1,612	28.8
1952.....	905	1,710	29.3
1953.....	926	1,797	30.2
1954.....	947	1,867	30.7
1955.....	970	1,935	31.2
1956.....	1,001	2,031	32.0

Illinois Tax Burden and Taxpaying Ability

The per capita burden of state and local taxes in Illinois is near the national average. In 1957, for example, Illinois state and local expenditures per capita were $233 compared with the national average of $242. The disparity in actual tax burdens is greater than these figures would indicate because Illinois is wealthier than most states.

As the figures below indicate, Illinois is spending slightly less than the national average in total expenditures and in almost every separate expenditure within table.

Function	Illinois (1957)	All states (1957)
Education	$ 79.79	$ 84.50
Highways	44.89	46.62
Public welfare	16.70	20.31
Hospitals and health	18.16	19.14
Police and fire	14.46	13.77
Natural resources	3.12	6.16
Sewage disposal, sanitation	11.43	8.87
General control	9.28	10.29
Miscellaneous	35.12	31.99
All general expenditures	$232.95	$241.65

Source: U. S. Census Bureau, *State and Local Government Finances in 1957* (1958).

Although Illinois collects less taxes from its citizens than most states, more taxable dollars are available in Illinois than in most states. Illinois per capita personal income has been well above the national average, as shown by the next that total.

Year	United States		Illinois	
	Total (millions)	Per capita	Total (millions)	Per capita
1948	$207,414	$1,420	$15,472	$1,809
1950	225,473	1,491	15,984	1,827
1952	269,050	1,727	18,579	2,085
1954	285,339	1,770	19,751	2,156
1957	345,272	2,027	23,579	2,447

Sources: 1948-1953, U. S. Department of Commerce. Personal income by states since 1929. 1956. 1954-1957, U. S. Department of Commerce. Survey of current business. August, 1958.

Another indication that Illinois' taxpaying ability is high is the large percentage of the federal tax burden that is borne by Illinois citizens and corporations. The estimated Illinois per capita rate for 1960 is exceeded by only four states: Delaware, Connecticut, New York, and Nevada. Federal taxes in Illinois for this year will be $543 per capita. The average for all the other states will be only $424 per capita.

It is estimated that the federal tax burden in 1960 will be allocated as follows:

Rank	State	Per capita rate	Total amount (millions)	Each billion in federal spending adds to state burden
1	Delaware	$958	$ 435	$ 6
2	Connecticut	717	1,660	22
3	New York	622	10,091	137
4	Nevada	581	155	2
5	ILLINOIS	543	5,370	73
6	New Jersey	541	3,113	42
7	Massachusetts	536	2,604	35
8	California	528	7,575	103
9	Ohio	486	4,544	62
10	Pennsylvania	479	5,318	72
11	Rhode Island	472	413	6
12	Maryland	469	1,387	19
13	Michigan	467	3,673	50
	National average	424		
	Total federal taxes, 1960		73,762[a]	

[a] A higher defense budget may increase this figure.

Basis and Character of Revenue

To be satisfactory any tax system must meet certain requirements of the taxpayer and of the government.

The taxpayer is interested in a just system of taxation. He enjoys the services of government, but he wishes to pay only his share. To determine the basis for his share is difficult. Most people would agree that ability to pay is a satisfactory basis. But how can we measure ability? The income tax is based upon ability to pay, but what size of income should be taxed, what rates of tax should be applied, and what exemptions, if any,

should be provided? The general property tax probably was relatively just on the basis of ability when most wealth was in land and nearly all of the people were farmers. At present, however, ownership of property, especially real estate, does not always indicate ability to pay taxes. Many kinds of property are not taxed at present because they are "intangible" forms of property, such as stocks, bonds, mortgages, and similar items.

Another basis for a taxation system is to adjust the taxes paid by an individual to the benefits he gets from taxes. The motor fuel tax approaches this basis since the more fuel purchased, the more tax paid.

From the standpoint of government administration, the tax system must meet seven standards:

1. **It must produce revenue.** That is, it must provide enough funds to pay for the services which the people need.
2. **It must be diversified** in order to tap the many forms which wealth may take.
3. **It must be flexible** enough to provide quickly for needed changes in income by adjusting the rates rather than by remaking the system.
4. **It must be worked out to minimize tax evasion** through which some citizens may avoid meeting their share of responsibility.
5. **It must be simple** in order to be readily understood.
6. **It must be economical.** The cost of collection must not take too great a percentage of the amount collected.
7. **It should in peaceful times permit essential economic growth and expansion.**

Taxes are sometimes classified according to the tax base on which they fall. The following is one such grouping.

Gross income — electrical energy tax, local telephone service tax, occupational excise tax.

Net earnings — income tax.

Production — severance tax, value added or value increment tax.

Wealth — personal property tax, real property tax, estate and gift taxes.

Consumption — amusement tax, occupational excise tax, use tax, motor-fuel tax, liquor tax, tobacco tax.

Privilege, license, and franchise — inheritance tax, occupational excise tax, stock transfer tax, amusement tax, motor-fuel tax, liquor tax, tobacco tax.

Possible New or Substituted Sources of Revenue in Illinois

The following are merely some of the many proposals advanced for consideration by the next Illinois General Assembly. Some could be enacted without constitutional change. Others would require amendment of the Constitution and referendum approval by the voters.

A few proposals would not bring in large additional amounts of revenue, but would plug existing loopholes and eliminate unfair exemptions. Others would provide substantial additional revenue and might permit better distribution of the total tax burden; for example, they would ease such apparent inequitable tax burdens as the high property taxes paid by Illinois farmers.

A. Impose a state income tax, either flat rate or graduated. As state revenue needs have increased, state income taxes have become increasingly popular and have been enacted in 34 states. These taxes bring in large amounts of revenue, are easy to collect, and require relatively

small administrative expense. The state income tax, for example, produces 60 percent of state revenues in Oregon, 50 percent in New York, and 47 percent in Wisconsin. Because of the need to file accurate federal returns, which are available for state inspection, tax evasion is difficult. Since state taxes are deductible for federal income tax purposes, the additional burden to state taxpayers would be less than the amount of revenue produced.[1] It is estimated that a rate graduated from 2 to 7 percent, with a personal exemption of $2,500 and an additional exemption of $400 for each dependent, would produce over $400 million annually from individuals and corporations in Illinois.

A flat-rate income tax could probably be enacted now with no constitutional amendment. It is presumed that a flat-rate tax would produce less revenue than a graduated tax, and would have the same regressive feature that is criticized in the various excises, but this is by no means certain, provided exemptions are allowed. Without reasonable exemptions the burden would be heaviest on the lower-income groups, who can least afford it. Estimates are that a flat-rate tax of 2 percent with individual exemptions of $700 would produce $330 million a year.

In recent years a number of groups in Illinois have come forward in support of a state income tax. Some farmer groups in particular have come to favor the imposition of such a tax. Their tax load under it would be relatively light, since the average net income per Illinois farm is $3,000 or less.

Income tax revenues could result in a lightening of the property tax burden if part of the revenue were used for local schools and the property tax levy were reduced proportionately.

B. Broaden the base of or increase the sales tax. High productivity of revenues and ease of collection have made sales taxes very popular at the state level, particularly in states like Illinois that have constitutional barriers to a graduated income tax. At present the Illinois sales and use taxes are the most productive source of revenue for the state, accounting for about 40 percent of total state collections. An increase of ½ percent in the present rate would bring in an additional $70 million in annual revenue, it is estimated.

Sales taxes, however, are heavily regressive on low-income groups in general, and upon the farm population in particular. In Minnesota, for example, it has been found that a farmer pays 50 percent more sales tax than a comparable urban resident because so much of his productive equipment is taxed. Therefore it would seem desirable, in terms of balance and diversification, for Illinois to keep the present rate and to expand the base of the sales tax.

Because of the wording of the statute and judicial decisions covering the sales tax, many exemptions exist. The words "tangible personal property" and "for use and consumption" have been interpreted to exclude sales that include an element of personal service, such as custom tailoring, machinery made to special order, newspapers and magazines, and certain made-to-order household furnishings. In addition, sales of personal property to contractors or to those in the service occupations are nontaxable. In short, although the Illinois statute is broadly phrased, it has been interpreted very narrowly.

C. Increase the rates on existing excise taxes. Like the sales tax, excise

[1] See page 102-106 in "Financing Illinois Government" by Glenn W. Fisher, University of Illinois Press, Urbana, 1960.

taxes are regressive, particularly for such products as cigarettes, which are used by a large percentage of the population. In the case of motor fuel, where the revenue is used only for road expenditures, the regressiveness of the tax may be justified because the driver is in effect taxed on the amount of use of the highways.

To produce any substantial increase in revenues, a number of excises would have to be increased. Increases on liquor and cigarettes were imposed in 1959, but Illinois still is substantially below the rates in some states.

D. Eliminate the capital stock tax and the bank share tax and substitute a flat-rate corporation franchise tax. Illinois corporations and other corporations doing business in Illinois are singularly fortunate from a state tax viewpoint, for they pay very few taxes in addition to the property tax. In fact, one authority, H. K. Allen, Professor of Economics at the University of Illinois, refers to "the relatively light burden of state taxes on most classes of business" in Illinois. This situation is particularly discomforting because business taxes can be passed on in part to nonresidents.

The situation could be remedied by abolishing such outmoded taxes as the capital stock tax and the bank share tax and substituting a flat-rate franchise tax that would be applicable to all corporations and measured by net income. In light of recent United States Supreme Court decisions, it is now also possible for Illinois to tax corporations in interstate commerce on the portion of their business that is attributable to Illinois.

An Illinois corporate franchise tax would produce a considerable amount of revenue. Compared with the $10 million that is now produced by the capital stock and bank share taxes, a franchise tax, at the rate of 4 percent on net receipts, would bring in more than $100 million. Because such taxes are deductible for federal corporate income tax purposes, the additional burden would be only half of the amount of state taxes corporations actually paid.

E. Other taxes. Other possibilities include a severance tax, a value-increment tax, an insurance tax, a motel and hotel tax, and numerous class-type taxes.

However, some of these do not meet the tests of a good tax and the class taxed often is too small to produce a substantial revenue. Yet other states do impose such taxes and they should not be discarded for use in Illinois until a study has been made of revenue needs and how each tax measures up to the standards listed in the preceding discussion "Basis and Character of Revenue."

The Property Tax Problem

This tax is maldistributed in relation to income and is not applied equitably to intangible wealth. These are serious objections, but a good substitute tax has not been found, with the possible exception of the income tax. It would take a substantial rate to replace the property tax on which well over a billion dollars is collected each year. Because the federal income tax imposes such heavy burdens, we shy away from a similar state tax. Much of this fear might be abated, however, if the Illinois constitution were amended to limit the rate and to set forth minimum personal and dependents' exemptions.

A constitutional amendment permitting personal property to be classified in such a way that it may be assessed at different percentages of value is another proposal that has been presented to the General Assembly. In those states in which this has been done, the personal property tax assessment has improved.

But avoidance of the property tax is still a problem in these states, so the solution is at best a partial one.

It appears that a substitute for the personal property tax is the best answer. (This, too, would require constitutional amendment.) Revenue lost from the personal property tax on vehicles could be replaced by a vehicle registration fee. A corporate franchise tax could be substituted for the capital stock tax. Any additional loss could be balanced by a general tax based on net income.

It is true that such substitutions would disrupt existing rate limits and debt limits. However, the fairer and more productive tax system that should result ought to outweigh these temporary inconveniences. In view of the future benefits to the citizens of Illinois, the ingenuity of our lawmakers should be able to surmount these obstacles.

Inventory Valuation and Farm Income[1]

WILLIAM A. TINSLEY

THIS ARTICLE IS CONCERNED with methods of inventory valuation and the effects of these methods upon estimates of aggregate farm income. Choice of an appropriate method of inventory valuation is also important in comparisons of the economic aspects of farming systems, in particular, comparisons involving year-to-year fluctuations in income. The income estimates of interest are those developed by the Agricultural Marketing Service for measuring total net farm income. Total net farm income differs from its counterpart realized net income in that it includes a value for inventory change. Realized net income is derived by subtracting total farm production expenses from realized gross farm income. Realized gross farm income includes the value of farm products sold or used in the farm home during the year, plus government payments to farmers, and the rental value of farm dwellings. Farm production expenses include depreciation charges for farm buildings and equipment as well as cash operating expenses.

Methods of Inventory Valuation

Three methods have historically been widely used to value farm inventories — the accrual method, the year-end methods, and the average-price method.

The accrual method requires the beginning inventory to be valued at the price prevailing at the beginning of the year and the ending inventory to be valued at the end-of-year price. This valuation method has been used extensively by farmers who utilize the accrual basis of tax computation and in most farm records in which measures of inventory change are desired.

The year-end method assumes no change in inventory prices between the beginning and ending inventory and uses the end-of-year price for valuation of both beginning and ending inventories. This method has in the past been used by the Agricultural Marketing Service in its "Total Net Farm Income" series and also by the Agricultural Research Service in its published farm income data.

However, the AMS now uses another

[1] A more complete treatment of this topic is presented in "Farm Inventory Valuation and Estimates of Aggregate Farm Income," unpublished Master's thesis, University of Illinois, 1960.

valuation procedure — the average-price method in which an average price is used to value both inventories.[2] For grain inventories, the average sale price of the particular grain during the year is used; for livestock, the average of the beginning and end-of-year prices is used. Like the year-end method, the average-price method does not stipulate any price differences between the beginning and ending inventories. The accrual method does. This lack of price variation is consistent with an objective of economic accounting (as opposed to business accounting), where only quantity changes are to be shown in the inventory-change value.[3]

Differences in Farm Income Estimates Due to Method of Inventory Valuation

Given these three methods of inventory valuation, we are interested in noting the yearly variations in total net farm income indicated by each of them. A comparison of the accrual and year-end methods shows that in periods of rising prices (all prices of inventory items increasing) the accrual method will always indicate a higher income than the year-end method. Conversely, in periods of falling prices, the year-end method indicates a higher income.

If we compare the accrual method and the average-price method, again assuming that all inventory prices move in the same direction, the accrual method results in a larger positive or smaller negative value when prices are rising. During falling prices the average-price method generates larger positive inventory changes than the accrual method.

When we compare the year-end method and the average-price method, we find that the relative year-to-year changes are dependent upon both prices and quantities and not upon price alone as was the case in previous comparisons.

Importance of Method Depends on Type of Farm

The difference that results from using the various inventory valuation methods may be illustrated by actual inventory changes computed by the three methods and by variations among the methods in respect to given years and also to the total income over a period of years. In this more complicated context, it is possible to note the importance of inventory change relative to realized farm income as well as the differences in inventory change generated by use of the valuation methods. In order to see some of these effects, total net farm income figures have been computed from data taken from USDA bulletins.

Costs and returns for commercial family-operated farms were analyzed by type and size for the years 1943-1957. It was not possible to compute the values for the average-price method from the data. However, inventory-change figures from the average-price method should be somewhat similar to those from the year-end method, which were computed and compared with those of the accrual method.

Six U. S. farming areas were chosen for the comparisons. As a measure of the importance of choice of inventory methods, the difference in values of inventory changes as computed by the two methods (accrual and year-end) may be expressed as a percent of the realized net income. The realized net income figure is, of course, not affected by the way in which inventories are valued. We find that this measure varies from area to area. The following summary

[2] Agricultural Marketing Service, U. S. Department of Agriculture. The Farm Income Situation No. 155, pages 25-27. 1955.

[3] Bassie, V Lewis. Economic Forecasting, page 226. New York, McGraw-Hill. 1958.

shows the average of 15 years of the absolute differences between the results of the two methods expressed as a percentage of the noninventory elements of total net farm income.

Cotton, black prairie, Texas.....10.1%
Winter wheat, southern plains...13.6%
Cash grain, corn belt.....18.6%
Hog — beef fattening, corn belt..20.1%
Dairy, central northeast.....25.1%
Intermountain cattle ranches.....80.2%

Since these are averages, they obscure some of the marked differences in the calculated change in inventory value that occur in years of substantial price changes. For example, on cash-grain farms in the corn belt in 1947, the difference between methods in the values of the inventory expressed as a percent of the noninventory elements of income was 54 percent. Inferences regarding the well-being of farmers in certain years certainly depended on the choice of an inventory-valuation method.

Obviously the importance of inventory change and therefore the importance of differences among methods vary both with farming areas and with the particular time period considered. The importance of the change figure depends on size of inventories relative to realized net farm income, the size of inventories held at beginning and end of year, price variation during the inventory period, and assortment of inventory items.

The empirical data show that for a number of years and for most of the farming areas, there was an important difference in total net farm income, depending on whether the accrual or year-end method was used. In 31 observations out of 90, the difference expressed as a percent of realized net income was greater than 25 percent. However, when the total net farm income figures generated by the two methods were summed for the 15 years involved, the differences between the means were not significant at the 1-percent level. Although there are large differences between the two methods in individual years, apparently these differences tend to cancel over a period of years.

Relation of Inventory Value to Actual Selling Price

If inventory-change values are considered as elements of farm income, then it might be asked if the prices assigned to inventories by the three inventory methods bear any consistent relationship to the ultimate selling prices of those inventories. To shed some light on this question, inventory data concerning three commodities — corn, wheat, and soybeans — were taken from *Illinois Agricultural Statistics*. The flow of these inventories to market was traced, and the actual sales values of the inventories were compared with the inventory prices established by the three valuation methods. The results of 13 years involving the three grains show that a beginning-of-the-year price (accrual method) came closest to valuing the beginning inventory at its eventual sales price 13 times out of 39, the average price was closest 14 times out of 39, and the year-end price 12 times out of 39. Ending inventories are priced only two ways by the three inventory-valuation methods. For ending inventories the average price was closer 22 years out of 39 and the year-end price was closer during the other 17 years. No one method provided consistent forecasts of the eventual sales value of inventories.

Choice of Method Depends on User

The use of inventory valuations in farm income estimates poses a fundamental problem — that of valuation it-

self. One accountant refers to the valuation problem as the "accountant's Achilles heel."[4] He points out the elusive nature of "value" and the need to use a valuation as a substitute for value and offers some criteria with which to appraise valuation methods. He says, "A whole series of valuations may be used in accounting for economic events to furnish information to those concerned. The choice among methods of valuation rests not on any proof of the correctness of any one valuation over another — but on questions of logic, usefulness, and measurability."

The year-end and the average-price methods have been used as convenient methods which are consistent with the physical change concepts of economic accounting, while the accrual method has been popular in farm firm accounting. In view of the possible differences among methods in studies where inventory valuations have a considerable effect on estimates of total net farm income, however, the user of farm income data might well consider certain questions: For the purposes for which the data are being used, are inventories a legitimate component of farm income? If so, since inventories are in reality farm assets, are not other less liquid assets just as valid a component of total net farm income?[5] Whether inventories are used or not, is a simple average income sufficient for the use in mind, or is some knowledge of the frequency distribution of various income classes needed?

Two groups of users of farm income data are usually thought of first — those who use income data for policy debate and those who use the data for forecasting purposes. For both users it would seem that realized net farm income would initially be most relevant to their purposes. The extent and method of valuing farmer-owned assets would, it seems, necessarily depend upon careful evaluation of the implications for the problem at hand of a twice-a-year valuation of these assets. A researcher who wishes to adjust for inventory changes the average 1952 intermountain cattle area realized net income of $9,357 would need to choose between $10,984, given by the year-end method, or −$6,893, given by the accrual method. In choosing one of these figures, some assumptions must be made concerning the relevance of the prices used in valuation to the relationships being studied and particularly the implications of inventory valuation to farmer behavior. If no formal tests of hypotheses are made at this point, the selection of an income figure rests largely on a judgment based on *a priori* reasoning.

Finally, it should be expected that farmer behavior would vary among income classes and that users of farm income data may be interested in a particular income group rather than an average of all groups. Thus far this type of information is not readily available.

All of these observations concerning inventory valuation have assumed that appropriate methods of sampling and estimating have been employed to develop gross revenue and farm expenses.

[4] Johnson, Charles E. Inventory valuation — the accountant's Achilles heel. The Accounting Review 29:15-26. 1954.

[5] See Grove, Ernest W. Farm capital gains — a supplement to farm income? Agricultural Economics Research 12:37-42. 1960.

Illinois Farmers Are Getting New Neighbors

C. L. FOLSE

AMONG THE MANY CHANGES that have taken place in the rural landscape, one of particular importance is that farmers are getting new neighbors — nonfarm families. The increase in number of nonfarm families living in the open country is one of the most significant population trends of recent times.

While most of these nonfarm families share many experiences with farmers, they differ from farm families in many ways. To the extent that their occupational interests and former residential backgrounds and social experiences are different, social and cultural values can also be expected to be different. Those who work with rural people must consider these differences in planning programs involving rural people.

The rapid shift of nonfarm families into the open country is changing the homogeneous rural community into more heterogeneous units. This change has further reduced the former differences between rural and urban residents. While mass media of communication have already brought much of urban culture and city ways to farmers, now many of their neighbors are urban-oriented.

The changing character and composition of the open-country population have had marked effects upon the traditional town-country community. Business, schools, and churches and other services in the rural community that formerly served almost exclusively the day-to-day needs of the farmer and his family are also experiencing changes. Some rural communities are growing, and the demands for additional services and facilities frequently strain the physical and economic resources of the community. On the other hand, some communities are declining; this requires retrenchments and adjustments in services that pose many problems.

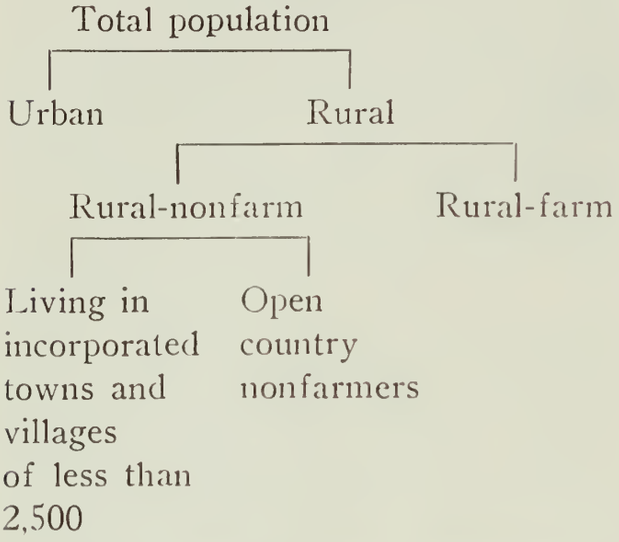
In growing communities demands from nonfarm families for new and additional facilities and services such as sewerage, public utilities, schools, churches, and recreational facilities are impossible to provide from a limited tax base. The older community residents frequently are asked to provide these facilities by increasing their taxes. The newcomer families who need these added facilities have limited financial resources that are taxable. For example, the problems of school expansion have become acute and form the focal point of contention and disagreement. Newcomers are usually relatively young families with growing children, and they want the best possible school facilities for their children. On the other hand, older long-established community residents have passed the stage in the family life cycle where there are large numbers of school-age children. Hence farmers are put in the position of voting increased taxes for school construction and support, thereby adding to their fixed costs of production and increasing the cost-price squeeze of recent years.

Because of these problems it is important at this time to describe and analyze the changes that have occurred in the composition and characteristics of the open-country population. This information will provide community leaders a factual basis for discussions and plans for satisfactorily settling the many perplexing problems that confront them.

Any cursory examination of gross population figures published by the Bureau of the Census reveals many impor-

tant changes. From 1940 to 1950 Illinois population increased from 7,897,000 to 8,712,000 — an increase of 815,000 or 10.3 percent.

For purpose of analysis, the total population will be broken down as indicated in the following diagram:



The urban population, including all those living in incorporated centers with 2,500 or more persons, increased 11.7 percent during the ten years, from 5,809,000 to 6,486,000. The rural population increased from 2,087,000 to 2,225,000, or 6.6 percent. It is within the rural population that some of the most dramatic changes took place.

In 1920 the Bureau of the Census first divided the rural population into the rural-farm population, which comprises all persons who live on farms, and the rural-nonfarm, which comprises the remainder of the rural population. The method for determining the residents of farms in the 1950 enumeration differed somewhat from the method used in the 1940 and earlier censuses. In 1950, persons who paid cash rent for their house and yard only were classified as rural-nonfarm; persons in institutions, summer camps, motels, and tourist camps were also classified as rural-nonfarm. While these changes in definition of rural-farm residents transferred some individuals from the farm classification in 1940 to the nonfarm group in 1950, they were not of sufficient magnitude to alter the basic trends discussed in this report.[1]

Between 1940 and 1950 the rural-farm population declined by 203,000, or 21 percent. The rural-nonfarm population is among the most heterogeneous in occupations and other characteristics of the residential groups enumerated in the census; it includes residents of incorporated centers with less than 2,500 inhabitants, unincorporated places, and the open-country population living in the fringes of cities. For our purposes the rural-nonfarm population consists of two major groupings: residents of incorporated centers of less than 2,500 and the open-country nonfarm population. The rural-nonfarm population increased dramatically between 1940 and 1950 from 1,119,000 to 1,460,000 — an increase of 341,000. This increase of 30.4 percent was the largest proportional increase among the three census groups of urban, rural-farm, and rural-nonfarm.

In the past a majority of the people living in the open-country areas were farmers while the remaining rural population, the nonfarmers, were largely residents of the small towns and villages that served as the focal points for the town-country community. In the past half-century, the number of inhabitants living in the small towns and villages has changed very litttle (Table 1). In 1900 there were 821 incorporated centers under 2,500 population having an aggregate population of about 607,000. By 1950 the number of such places had

[1] The forthcoming population figures from the 1960 census will not influence the trends indicated. The preliminary data show that farm population is continuing its decline, and the open-country nonfarm population is increasing.

Table 1. — Illinois Rural-Nonfarm Population Living in Incorporated Centers of Less Than 2,500 Inhabitants, 1900 to 1950

Census year	Number of places	Population	Increase (+) or decrease (−)
1900.....	821	606,797	121,277 (26.0%)
1910.....	922	675,502	68,705 (11.3%)
1920.....	940	680,740	5,038 (7.5%)
1930.....	956	651,268	−29,472 (−4.3%)
1940.....	932	663,819	12,551 (1.9%)
1950.....	912	660,393	−3,426 (−0.5%)

grown to 912 and included 660,000 persons. In 50 years the population in these places grew about 50,000 or by 8.8 percent. During the decade from 1940 to 1950, the population declined by 3,426 — less than 1 percent. Although the number of rural incorporated centers fluctuated from decade to decade over the past fifty years, the total incorporated rural population remained rather stable.

The changes in rural population can be viewed in another way by combining all the people who live in the open-country into one group. This would include the census category of rural-farm population plus that portion of the rural-nonfarm population living outside of the incorporated centers discussed in the preceding paragraph. Unfortunately, trends in the number of open-country residents cannot be examined before 1920, when the census first separated the farm and nonfarm groups. In 1920 about eight out of ten open-country residents were classified as farm and the remainder nonfarm (Table 2). With each passing decade since 1920, the open-country farm population declined numerically as well as in proportions of the total open-country population (Figure 1). In 1950, farm population represented 48.9 percent and the nonfarming population 51.1 percent of all open-country residents. In the thirty years, Illinois farmers became not only a minority of the state's total and rural population but also a minority of the open-country population.

Table 2. — Illinois Open-Country Population Classified by Farm and Nonfarm Residence, 1920 to 1950

Census year	Total open-country population	Classified as:	
		Rural-farm	Open-country nonfarm[a]
1920	1,400,863	1,090,736 (77.9%)	310,127 (22.1%)
1930	1,343,659	991,401 (73.8%)	352,258 (26.2%)
1940	1,423,772	968,103 (68.0%)	455,669 (32.0%)
1950	1,565,110	765,277 (48.9%)	799,833 (51.1%)

[a] To determine open-country nonfarm, the populations of the rural incorporated places in each county were added and this total then subtracted from the county's reported total rural-nonfarm population. In 1950, the Bureau of the Census gave 20 rural unincorporated centers that could be identified by name the same status as incorporated centers; these aggregations are, however, here treated as open-country population to make the figures comparable with those for 1940.

Farm population decreased in all counties between 1940 and 1950. Declines varied from 5.4 percent in Boone to 41.4 percent in Alexander county (Figure 2). With the exception of Macon and Morgan, counties declining 30 percent or more were concentrated in southern and southeastern Illinois. Counties with the smallest percentage losses were in northeastern and northwestern Illinois. Forty-eight counties showed losses exceeding 21 percent — the average for the entire state.

The percentage changes in the open-country nonfarm population are shown

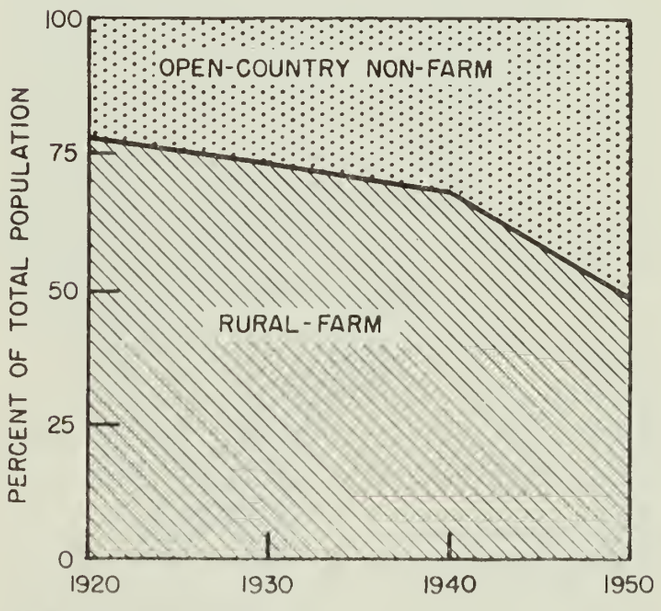


Fig. 1. — How farm proportion of open-country population has declined.

in Figure 3. Ninety-five counties increased and only seven lost open-country nonfarm residents during this ten-year period. Increases varied widely among the 95 counties, with gains ranging from 1.2 percent in Perry to almost 500 percent in Gallatin county. Gains in open-country nonfarm population occurred both in counties influenced by the large cities and in the most rural counties.

Thirty-two counties had increases of 100 percent or more in their open-country nonfarm population. It is interesting to note that of the counties showing heavy gains in open-country nonfarm population, only Cook, Du Page, Lake, Macon, Madison, Rock Island, and Tazewell are within the standard metropolitan areas. The remaining 25 counties are in the nonmetropolitan areas. The metropolitan counties of Cook, Du Page, Kane, Lake, Macon, Madison, Peoria, Rock Island, Sangamon, St. Clair, Tazewell, Will, and Winnebago accounted for 236,745, or 68.2 percent of the total open-country nonfarm population increase; and 89 nonmetropolitan counties had an aggregate growth of 107,421, or 31.8 percent. In recent years much has been heard about the growth of nonfarm population in the fringe areas of the largest cities. It is obvious that Illinois open-country population grew markedly in the fringes of the largest cities but that there was also a significant growth in the most rural counties of the state. It therefore appears that even in the most rural and predominantly agricultural areas more and more people with nonfarming occupations are living in the

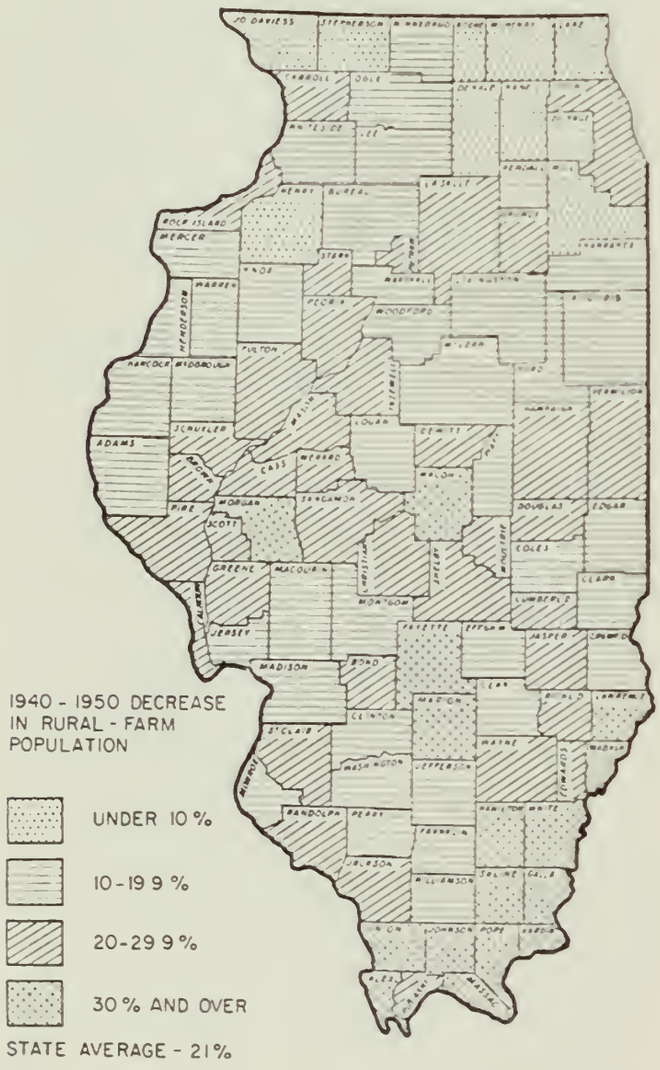


Fig. 2. — 1940-1950 decrease in rural-farm population.

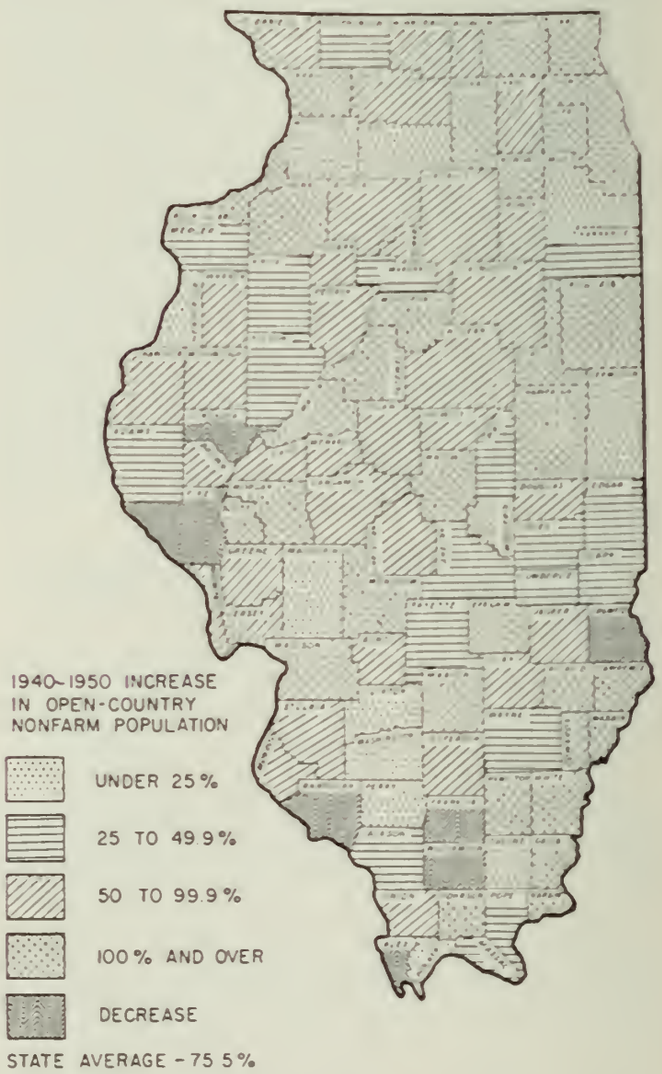


Fig. 3. — 1940-1950 increase in open-country nonfarm population.

open-country as neighbors of bona-fide farmers.

A comparison of Figures 2 and 3 clearly shows that the open-country nonfarm population grew most rapidly in some of the same counties where substantial losses occurred in farm population. This is particularly evident in the open-country nonfarm population growth in Lawrence, Wabash, White, Hamilton, Gallatin, Hardin, Marion, and Johnson counties, where there were losses of more than 30 percent in farm population. These data suggest the hypothesis that while some farmers may have left agriculture as an occupation between 1940 and 1950 they continued to live in the open country and were counted as nonfarm residents in 1950. Unfortunately this hypothesis cannot be tested from available information. However, it seems reasonable to suggest that many rural-farm families, although no longer employed in agriculture, are living on farms and are partially responsible for the growth and increased occupational heterogeneity of the open-country nonfarm population.

Another way to compare the relative growth of the rural-nonfarm families living in the open country is to examine the change in ratio of this part of the open-country population to the total open-country population in 1940 and 1950. Without exception the percentage of the total open-country population classified as nonfarm increased in each county while the population of farmers declined. In 1940, 48 counties had less than 15 percent open-country nonfarm population and 93 had less than 50 percent. Ten years later only seven counties (Jo Daviess, Brown, Jasper, Ford, Marshall, Hancock, and Shelby) had less than 15 percent and 83 had less than 50 percent. At the upper end of the scale, Will, Cook, and Lake were the only counties in 1940 with more than 70 percent open-country nonfarm population. By 1950 six counties had more than 80 percent of their open-country population classified as nonfarm.

The increasing number of nonfarm families living in the open country that was formerly thought of as predominantly the residence of farmers gives rise to many social and economic problems:

1. The settlement of nonfarm families in unincorporated areas is largely unplanned. Incorporated centers are frequently faced with providing additional public utility, fire, police, sanitary, and transportation facilities for outlying areas. Because of higher taxes within incorporated centers, open-country nonfarm residents resist attempts at annexation.

2. The lack of planning orderly development may result in such undesirable land use as taking highly productive land for residential purposes when less-productive land is available. The amount of good productive agricultural land is limited and cannot be expanded to meet future demands for food production. Political subdivisions including counties, incorporated villages, towns, and cities should undertake vigorous efforts to plan future development through well-conceived zoning ordinances. This would serve to insure orderly development of future incorporations and annexations and at the same time preserve the best land for agricultural production.

3. Current institutional services such as school, religious, recreational, health, medical care, and related services make excessive demands upon existing facilities. The difficulty of providing additional facilities with limited tax revenues is well illustrated in the present school situation. Increased school enrollments

have overtaxed existing physical plants and created demands for additional teachers. Although maximum tax rates are imposed, revenue from property taxes is inadequate to provide for increased school services, and local schools have to rely more and more on state aid. Farmers are faced with increasing tax burdens, which add to their cost of production, to support schools for more and more children from nonfarm families. Most nonfarm families own a limited amount of property, consisting of house and lot and personal property.

4. Problems of social adjustments and minimizing conflicts between farm and open-country nonfarm residents are ever present. Many local committees find it difficult to integrate these groups into harmonious social relationships. Basically, tensions result from differences in values between "older community residents" and "newcomers." The differences in ages of these groups are also important.

5. While the agricultural segment of the open-country population represents owners, renters, tenants, and farm laborers living on commercial, part-time residential, and subsistence farms, the nonfarm residents include an even greater variety of occupational interests ranging from the least-skilled laborers to highly skilled professionals. Some own their own homes, others are renters. The houses in which they live vary from mansions to the tarpaper shacks of the squatter. The open-countryside is rapidly taking on the complex characteristics of the city.

On the basis of present trends, it is safe to assume that the rural open-country population will continue to increase and the farm population will decline or become stabilized. Under these conditions open-country areas will assume more mixed rural-urban characteristics. This development should be of concern and interest to leaders who work with rural groups. As the number and variety of social contacts and relationships among and between farmers and nonfarmers increase, a vastly different kind of social structure will develop in rural communities. Professional agricultural leaders may find it profitable to capitalize on the leadership and the variety of organizations that are developing in the open country.

While the information presented here should be useful to leaders at various levels of responsibility, it is limited and general. We need to know more about the age, sex, education, marital status, religions, occupations, and industrial compositional structure of the open-country nonfarm population. Little is known of why nonfarm people move into the open country, and even less is known about the social and economic forces that "pull" people into some areas and those that "push" them out of others.

Basic information of this kind can aid in intelligent planning to insure an orderly development of the countryside. The costs of such studies and planning may be cheaper in the long run than allowing the haphazard growth and development that prevailed in the past. Intelligent planning, moreover, will not only insure a desirable kind of community life that will be satisfying to the farming and nonfarming inhabitants but will insure that the best agricultural resources are being maintained for future production of food and fiber to feed an increasing population.

Relation Between Moisture Content of Corn Stored at Harvest and Subsequent Damage

MAX R. LANGHAM and R. J. MUTTI

EAR CORN STORED AT MOISture contents that exceed certain levels may incur kernel damage which leads to price discounts when sold the following spring. Estimating this damage and discounts is a matter of some concern to both farmers and grain handlers. The objective of the study reported here was to discover how much kernel damage is associated with variation in the level of moisture at harvest, and to ascertain when such damage becomes a relevant cost of storage for farmers or grain merchandising firms.

Basic data were secured from official inspection certificates on corn shipments made by two farmer-owned grain firms: the Fisher Farmers' Grain and Coal Company (for the crop years 1944-45 through 1957-58) and the Peotone Farmers' Elevator Association (for the crop years 1940-41 and 1942-43 through 1957-58). The monthly averages computed from these certificates are believed to be representative of corn moving off farms in the market areas about each firm. Figures for individual farms, of course, would show a wider range than the figures reported here.

Variations in Damage in Fisher Area

The percentage of damage averaged highest on shipments made in May, July, and August (Table 1). The year-to-year variability in damage was greatest in April and May, and the greatest average change in damage from the previous month was in April. In the 14 years for which records are available, damage increased from March to April during

Table 1. — Average Percent of Damage in Corn Shipped From Fisher, Illinois (Crop Years 1944-45 Through 1957-58)[a]

Year	October	November	December	January	February	March	April	May	June	July	August	September
1944-45	2.5[b]	2.5[b]	3.6	2.4	2.3	2.5	6.1	3.9	5.0	4.4[c]	4.4[c]	4.4[c]
1945-46	1.2[b]	1.4	1.5	1.5	1.4	1.4	2.2	2.0	2.3	1.2	1.5	1.4
1946-47	1.1	1.3	1.1	1.1	1.3	1.0	1.3	1.9	1.9	1.4	1.0	1.1
1947-48	1.4[b]	1.5	1.5	1.8	1.8	2.7	5.8	5.8	4.6	4.0	3.4	3.3
1948-49	1.3	1.3	1.5	1.3	1.4	1.4	1.4	1.2	2.0	2.5	2.6	2.3
1949-50	3.3	3.7	3.9	3.5	4.3	4.1	4.4	4.0	3.9	3.9	4.0	3.7
1950-51	2.5[b]	2.4	2.6	3.0	2.7	3.3	2.7	5.3	2.2	4.8	3.1	4.8
1951-52	1.6	1.7	2.2	1.6	1.3	2.1	2.2	4.1	2.8	3.2	4.8	3.3
1952-53	1.6	1.8	1.7	1.9	3.1	2.0	2.0	2.5	1.8	3.2	2.3	2.1
1953-54	1.4	1.8	1.8	1.9	2.0	1.4	1.6	1.7	1.9	2.4	2.9	2.2
1954-55	3.6	3.0	3.2	4.3	3.7	4.1	3.5	4.1	4.3	3.8	4.7	3.8
1955-56	1.7	1.9	2.4	2.1	2.0	2.0	1.7	2.1	2.6	2.0	2.4	2.4
1956-57	1.7	1.5	1.7	1.9	1.9	1.9	1.5	1.7	1.6	2.9	2.5	2.4
1957-58	1.0	1.2	1.7	1.8	1.6	2.1	3.6	3.0	3.1[c]	3.1[c]	3.1[c]	3.1[c]
Sum	25.9	27.0	30.4	30.1	30.8	32.0	40.0	43.3	40.0	42.8	42.7	40.3
Mean	1.85	1.93	2.17	2.15	2.20	2.29	2.86	3.09	2.86	3.06	3.05	2.88
Standard deviation	.78	.70	.83	.85	.90	.93	1.55	1.39	1.10	1.04	1.10	1.04
Mean change from previous month		.08	.24	−.02	.05	.09	.57	.23	−.23	.20	−.01	−.17

[a] Percentages include all types of kernel damage.

[b] Voids in the data during these months were handled in the following way: An extrapolation of 0.3 percent under the December, January, February average was made for voids in October and November. This 0.3 percent figure was derived by averaging the data during the ten years in which there were no voids in the October and November data.

[c] Voids in June, July, August, and September were extrapolated 0.2 percent over the March, April, May averages. This 0.2 percent was arrived at by averaging the data for the 12 years when there were no voids during these months (1945-46 through 1956-57). The average during these 12 years for March, April, and May was 2.6 percent and for June, July, August, and September 2.8 percent.

Table 2. — Average Percent of Damage in Corn Shipped From Peotone, Illinois (Crop Years 1940-41 Through 1957-58)[a]

Year	October	November	December	January	February	March	April	May	June	July	August	September
1940-41	2.4[b]	2.6	2.6	3.2	2.8	3.4	2.6	3.8	3.7	2.1	3.8	4.2
1941-42	Record not available for this year											
1942-43	2.6[b]	2.5	3.1	3.3	2.9	3.9	4.0	4.3	9.7	7.2[c]	4.6	4.5
1943-44	2.2	1.8	2.8	2.3	3.2	4.9	6.3[c]	7.6	8.1	3.7	5.6	8.6
1944-45	2.1	2.4	1.8	2.1	2.0	2.4	5.4	7.0	9.2	7.2[c]	5.2	8.4[d]
1945-46	1.0	1.9	1.6	3.0	2.7	3.2	5.6	7.8	8.0	2.9	6.2	3.0
1946-47	1.1	1.1	1.6	1.2	1.3	3.3	1.7	1.2	5.8	3.7	5.0[d]	5.0[d]
1947-48	1.4	1.5	1.1	1.2	1.0	1.3	6.0	4.7	5.8	5.1	4.5	2.8
1948-49	1.8	2.2	6.0	4.2	4.8	6.6	10.6	8.7	6.4	9.2	8.4	7.8
1949-50	2.1	2.3	1.8	2.0	1.5	2.1	2.3	2.6	3.1	3.1	2.9	3.1
1950-51	2.4	2.4	1.7	2.2	3.3	2.6	5.2	6.7	8.6	5.7	8.7	8.0
1951-52	1.5	1.7	2.1	2.6	2.6	5.3	7.5	10.2[e]	7.6	17.8[e]	15.8[e]	7.7
1952-53	1.1	2.5	1.6	.9	1.2	1.3	1.7	1.8	3.9	1.8	1.7	2.0
1953-54	1.1	.9	1.1	1.0	.9	.7	.9	1.2	1.1[c]	1.0	1.2[d]	1.2[d]
1954-55	2.3	2.1	2.2[c]	2.4	2.3	2.7[c]	3.1	3.6	3.5	3.4	8.4	3.5
1955-56	2.0	1.6	1.8	1.5	1.7	1.5	2.1	2.4	2.5	3.4	2.7	2.9
1956-57	1.1	1.1	1.8	1.1	1.4	1.2	1.4	2.2	1.8	2.2	2.4	2.4
1957-58	2.9	1.0	1.3	1.4	1.0	1.6	2.3	3.1	3.9	7.0	5.7[d]	5.7[d]
Sum	31.1	31.6	36.0	35.6	36.6	48.0	68.7	78.9	92.7	86.5	92.8	80.8
Mean	1.83	1.86	2.12	2.09	2.15	2.82	4.04	4.64	5.45	5.09	5.46	4.75
Standard deviation	.60	.57	1.11	.92	1.03	1.58	2.55	2.73	2.65	3.87	3.39	2.40
Mean change from previous month		.03	.26	−.03	.06	.67	1.22	.60	.81	−.36	.37	−.71

[a] Percentages include all types of kernel damage.

[b] Voids in the data during these months were filled by extrapolating 0.2 percent under the November-December average for that year. This 0.2-percent figure was obtained by averaging the data during the 14 years there were no voids in October, November, and December.

[c] During these months either no corn or only one car was shipped. The figure shown is an interpolation between the preceding and the succeeding months.

[d] Voids in data during these months were filled by extrapolating 0.2 percent over the June-July average for that year. This 0.2-percent figure was arrived at by averaging the data during the 12 years there were no voids in June, July, August, and September.

[e] Shipments in these three months were less than one-third those in the three months of April, June, and September and their average damage was greatly affected by an exceptionally high damage on a very few cars.

eight years. In six of these years, when the moisture content of corn during the early part of the storage period was above the 14-year average, increases in damage averaged 1.57 percent, compared with only 0.25 percent in the other two years when the moisture content was below the 14-year average (Table 3). Thus subsequent damage has been more frequent and higher during years when moisture content of corn during the early storage period is above average.

From the middle of February to the middle of May appears to be the critical period with respect to quality deterioration in storing high-moisture corn. The greatest amount of natural drying of ear corn in storage[1] also occurs during March and April. Farmers holding ear corn make maximum gain from natural drying during these months. These gains are possible because the moisture discounts used by grain buyers (to cover weight loss, cost of drying, and risk) exceed the value of the weight loss in drying. In only three years in the Fisher area was the average damage high enough in any month to incur a price discount.[2]

Results of regression analyses for Fisher area. Changes in damage between two time intervals of the storage period were computed and correlated with the average moisture content of the corn during the early part of the storage

[1] Mutti, R. J., and Langham, Max R. Effects of moisture losses on costs of storing ear corn. Illinois Agricultural Experiment Station Bulletin 653, pages 6-7. 1960.

[2] Five percent is the maximum limit of damage allowable for corn to grade No. 2. Discounts for damage by the grain trade are not specified until the damage content reaches 5 percent, and thereafter are one cent for each percent or fraction thereof.

Table 3. — Basic Data for Computing Relationship of the Moisture Content of Corn With Subsequent Damage Changes, Fisher Area

Crop year	Change in damage from the average for Nov., Dec., and Jan. to average for April, May, and June[a]	Average moisture content of corn for Nov., Dec., and Jan.[a]	Average March-April relative humidity, 12:00 CST[b]	Average March-April mean temperature[c]
	X_1	X_2	X_3	X_4
1944-45	2.2	19.4	62	51.8
1945-46	.7	19.1	54	53.2
1946-47	.5	19.2	65	42.7
1947-48	3.8	21.1	63	47.9
1948-49	.1	19.2	57	46.0
1949-50	.4	16.1	60	41.2
1950-51	.7	18.3	65	43.1
1951-52	1.2	19.2	58	46.0
1952-53	.3	16.7	59	45.8
1953-54	−.1	13.3	56	47.6
1954-55	.5	16.9	56	49.6
1955-56	.0	16.2	48	44.8
1956-57	−.1	15.3	60	46.2
1957-58	1.6	20.5	56	44.6
Mean	.843	17.893	58.500	46.464
Standard deviation	1.038	2.111	4.420	3.245

[a] Computed from data from the records of the carlot shipments of corn from the Fisher Farmers' Grain and Coal Company.

[b] From data reported by the Springfield Weather Bureau, Springfield, Illinois. This is the closest station reporting the mid-day (CST) relative humidity for the years included in the study.

[c] From data reported by the Urbana Weather Bureau, Urbana, Illinois.

In addition to the equation presented in the next column, the following equation was computed:

$$X_1 = 13.3958 - 2.4642\ X_2 + .0799\ X_2^2 + .0489\ X_3 + .0589\ X_4$$
$$(1.2569) \quad (0.0362) \quad (0.0437) \quad (0.0577)$$

S = .5227 R = .8641

period. The change in damage was computed by subtracting the average of the damage in November, December, and January from the average damage in April, May, and June (Table 3). The moisture content of the corn during the early part of the storage period was determined by averaging the average November, December, and January moisture contents (Table 3).

During the first part of the storage period — November through January — corn normally shows little change in moisture content,[3] and the increase in damage during these months has usually been small. By the end of the second part of the storage period — April through June — corn in storage has dried down to a moisture level where large increases in damage are unlikely to occur. The increase in damage over the previous month in both April and May was well above average. In these two months the moisture content of the corn generally dries to a level at which there is no moisture discount (15.5 percent or less). Since hardly any increase in damage would be expected with a moisture increase from 13 to 15 percent and a sizable damage change would be expected in a moisture increase from 22 to 24 percent, a curvilinear relationship was computed.

The results of the regression analysis yielded the following estimating equation (standard errors of the regression coefficients are in parentheses):[4]

$$X_1 = 20.4241 - 2.6807\ X_2 + .0874\ X_2^2$$
$$(1.2281) \quad (0.0353)$$

X_1 = change in damage from the first to the second part of the storage period

X_2 = moisture content of corn during the first part of storage period

R = .8350 S = .5713

The net regression coefficients are significantly different from zero at the 5-percent level.

Figure 1 shows the data plotted about the regression line indicated by this equation. With the maximum allowable damage of 5 percent for No. 2 corn and an average 2-percent damage at harvest, the 5-percent-damage level would be realized when corn testing above 21.2 percent was stored.

A second regression in which two additional independent variables — average relative humidity and average mean temperature — were included gave only a slightly higher correlation coefficient (R = 0.864), but the regression coefficients of these additional variables had a very low level of significance (Table 3, footnote c).

[3] Illinois Bulletin 653, previously cited.

[4] Data used in the analysis are in Table 3.

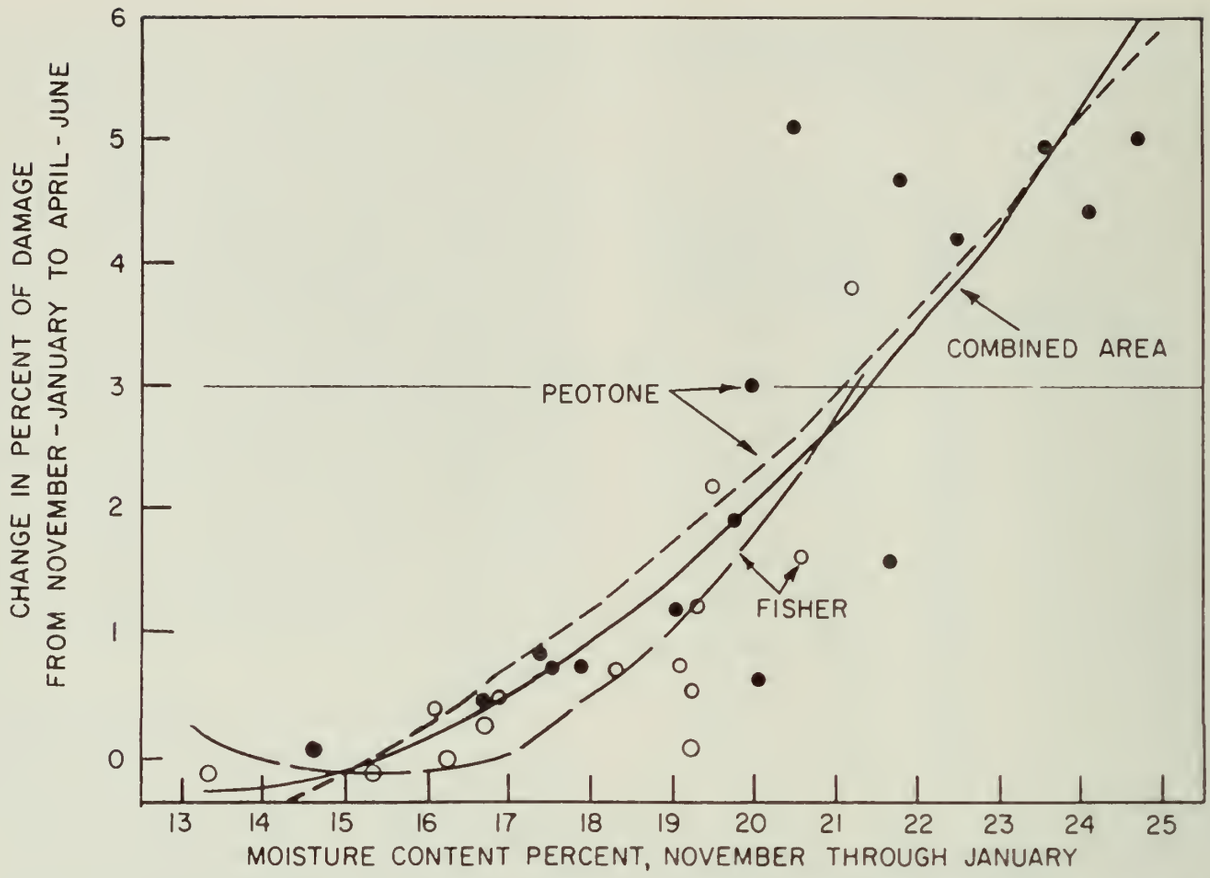


Fig. 1. — How moisture content early in storage period related to percent of damage in areas studied.

Variations in Damage in Peotone Area

To obtain damage observations at a higher moisture level, data from the Peotone area were also analyzed. The greatest average damage in grain was found for shipments after March (Table 2). Year-to-year variability was especially high during July and August, and the greatest average increase from one month to the next in damage occurred between March and April (1.22 percent).

During 11 of 17 years, damage in at least one month exceeded 5 percent. Damage increased from March to April in 15 of the 17 years. The increase in damage from March to April averaged 3.0 percent in the eight years when the moisture content of corn from November through January was above the mean, compared with 0.2 percent in the nine years when the moisture content was below the mean. The range in variability about the average damage was much greater for the years when the moisture content was higher.

Results of regression analysis for Peotone area. The coefficient of correlation ($R = 0.874$) is slightly higher for the Peotone area than for the Fisher area, but the standard error of estimate ($S = 0.984$) is much greater. The correlation coefficient is slightly higher and the standard error somewhat lower when data for the Fisher and Peotone areas are combined than for the Peotone area data alone. The regression lines and estimating equations are shown in Figure 1 and in Table 4.

The regression coefficients ($b_{12.3}$ and $b_{13.2}$) for the Peotone area are not significant at an acceptable level. The coefficients for the Peotone and Fisher data combined are significant at the 10-percent and 2-percent levels, respectively.

If corn has 2-percent damage at harvest, discounts for damage will start when the change in damage exceeds 3

Table 4. — Basic Data for Computing Relationship of the Moisture Content of Corn With Subsequent Damage Changes, Peotone Area[a]

Crop year	Change in damage from the average for Nov., Dec., and Jan. to average for April, May, and June	Average moisture content of corn for Nov., Dec., and Jan.	
	X_1	X_2	X^2_2
1940-41	.6	20.0	
1941-42	Record not available this year		
1942-43	3.0	19.9	
1943-44	5.0	24.6	
1944-45	5.1	20.4	
1945-46	4.9	23.5	
1946-47	1.6	21.6	
1947-48	4.2	22.4	
1948-49	4.4	24.0	
1949-50	.7	17.5	
1950-51	4.7	21.7	
1951-52	6.3	24.8	
1952-53	.8	17.4	
1953-54	.1	14.6	
1954-55	1.2	19.0	
1955-56	.7	17.9	
1956-57	.5	16.7	
1957-58	1.9	19.8	
Mean	2.688	20.341	422.020
Standard deviation	2.027	2.873	116.335

[a] Computed from data taken from the records of the carlot shipments of corn from the Peotone Farmers' Elevator Association.

The estimating equation is:

$$X_1 = .1026 - \underset{(1.2198)}{.3845\,X_2} + \underset{(0.0301)}{.0247\,X^2_2}$$

$R = .8743$ $S = .9841$

The estimating equation obtained by combining these data with the data given in Table 3 is:

$$X_1 = 6.8901 - \underset{(.6445)}{1.1180\,X_2} + \underset{(.0165)}{.0436\,X^2_2}$$

$R = .8894$ $S = .8667$

percent. The horizontal line in Figure 1 shows that the regression lines cross this 3-percent line between 21 and 22 percent.

The regression line for the Peotone area has less curvature than that for the Fisher area. This difference suggests that corn stored at a relatively high level, say 23 percent, would be susceptible to more damage at Fisher than at Peotone (where the mean temperature is slightly lower in winter). Since data for Fisher do not cover corn stored above the 23-percent level, this implication cannot be meaningfully tested.

In 17 years of record at Peotone, damage in May exceeded 5 percent in six years; the discount for damage was 3 cents a bushel or less in four of these years, and the average gain from natural drying was 3.19[5] cents. These data show that by holding corn until May damage would have exceeded the gain from natural drying in only two of the 17 years.

The northern location is characterized by higher-moisture corn. Farmers in this area may therefore need to use more care in their storage operations in order to minimize damage. Using narrower cribs to permit faster drying, locating the cribs in open areas, and other practices would facilitate maximum natural drying with a minimum of damage during the storage period.

Moisture Level at Harvest at Which Subsequent Variable Storage Costs and Damage Costs Are Minimized

Six situations involving different levels of moisture at the end of the storage period and different assumed variable storage costs[6] are illustrated in Figure 2 for the Fisher area. The farm price of corn at the beginning of the storage period was assumed to be $1.00 a bushel. The price needed at the termination of the storage period was determined by the following formula:

$$P_t = [P_b - (X_2 - 15.5)\,.02_i + C_s + k\,(17.4241 - 2.6807\,X_2 + .0874\,X_2^2)]\left[\frac{100 - M_t}{100 - X_2}\right] + (M_t - 15.5)\,.02_j$$

P_t = price of No. 2 yellow corn at termination of storage period, dollars per bushel

P_b = price of No. 2 yellow corn at beginning of storage period

M_t = expected moisture content of corn at termination of storage period, stated as a percentage

X_2 = moisture content of corn at beginning of storage period

C_s = variable costs of storage, dollars per bushel, excluding costs or gains associated with natural drying

[5] Computed from Table 5 of Bulletin 653, previously cited.

[6] Based on data on page 18 in Bulletin 653, previously cited.

i = use 1 for moisture discount if X_2 is greater than 15.5, but 0 if X_2 is 15.5 or less

j = use 1 for moisture discount if M_t is greater than 15.5, but 0 if M_t is 15.5 or less

k = use .01 for damage discount if X_2 is greater than 21.0, but 0 if X_2 is 21.0 or less. Note that the portion of the equation multiplied by this dummy variable is equal to the right side of the estimating equation for the Fisher area minus 3. Generally corn averages around 2-percent damage at harvest, so the first 3-percent increase in damage in stored corn incurs no discount.

At harvest X_2 and P_b will be known. M_t and C_s may be estimated from data given in Illinois Bulletin 653, pages 6-8, 18, and 21.

Each of the lines in Figure 2 shows that the price needed to cover expected costs (exclusive of storage space) is lowest for corn harvested between 21- and 22-percent moisture. When corn is harvested at a lower moisture percentage than 21, less gain is realized from natural drying, and when corn is harvested at a higher moisture level than 21, the influence of discounts for damage exists.

Note the relatively small amount of additional return per bushel needed to cover costs when the moisture content at harvest increases from 21 to 25 percent (in all six examples it was less than 3 cents a bushel).

The broken portions of the curves (beyond 21.5-percent moisture) represent extrapolations beyond the range of the observed data at Fisher; they are presented because they are believed to be indicative of the general direction in which the curves move.

Figure 2 also shows a similar set of break-even curves for the Fisher and Peotone data combined. These curves all show that a minimum price rise is required to cover costs when the moisture content at the beginning of the storage period is 22 percent.

Individual farm experiences suggest that the break-even curves will increase

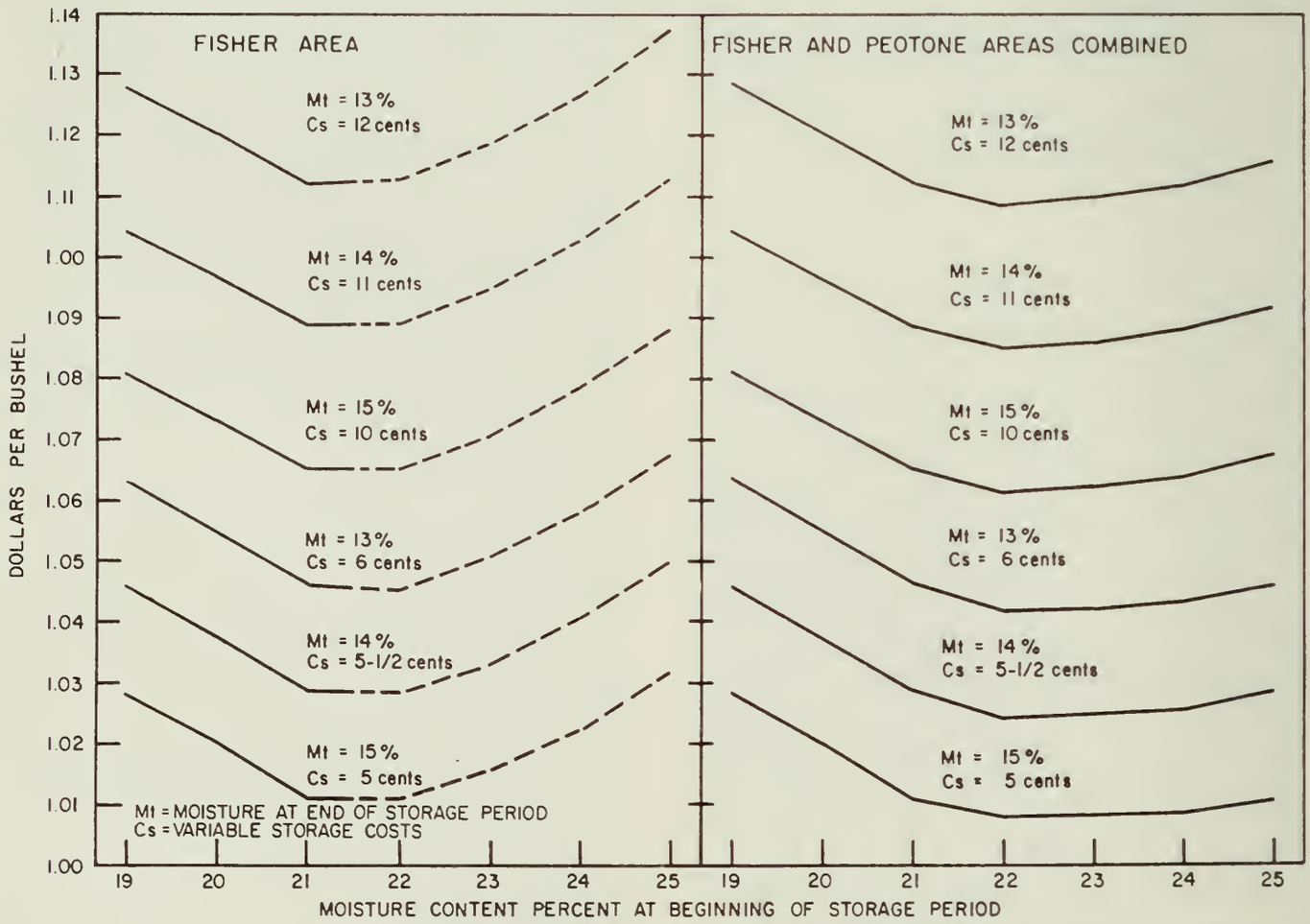


Fig. 2. — Price per bushel needed for ear corn to cover variable storage costs and damage. (Price at beginning of period assumed to be $1.00 for No. 2 corn, with moisture discounts of 1 cent for each 0.5 percent above 15.5.)

more sharply at the higher moisture levels. In this study data limitations have prevented the measurement of other factors affecting damage, such as weather conditions during the storage period.

Summary

Changes in the percent of damage in corn during the storage period are related to the moisture content at the beginning of the storage period. On the average, the storing of high-moisture corn will entail some damage discount whenever the moisture content is above 21 to 22 percent. This does not mean that a farmer should not take this risk of kernel damage. A farmer may be faced with an alternative of storing corn at moistures higher than 21 to 22 percent or suffering other unfavorable conditions, such as heavier field losses. In such a case, he may elect to take this risk. A second regression using two weather factors (temperature and relative humidity) as independent variables along with moisture content of the corn at beginning of storage failed to yield coefficients with an acceptable level of significance. These coefficients were logically consistent with respect to sign. Observation over a longer period of time could make such an analysis more meaningful.

Damage has not been a relevant cost factor in ear-corn storage when corn with less than 21-percent moisture at harvest has been stored. Corn stored between 21-percent and 23-percent moisture usually carries a damage discount, which is offset by a gain in natural drying if the corn is sold in May; if the corn is held past May, the damage discount and loss in weight add to storage costs and can only be recovered through a price rise sufficient to meet these costs.

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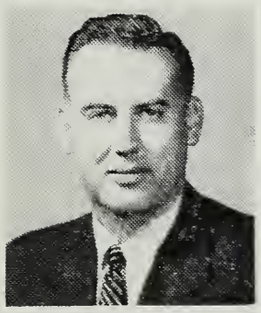

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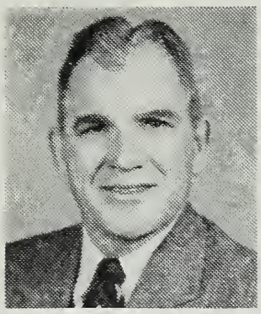

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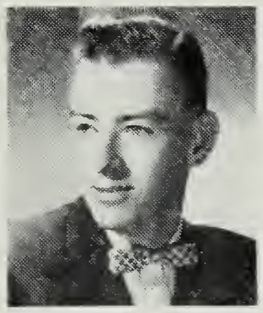

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